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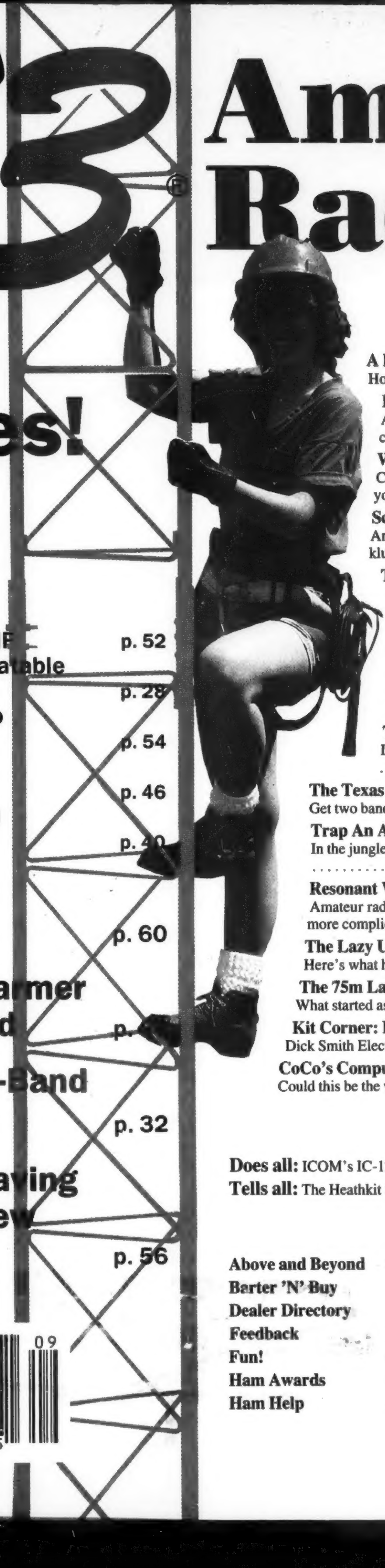

Sky Wires!

12 Hot Antenna Projects

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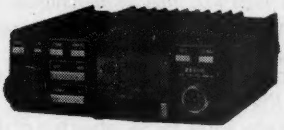

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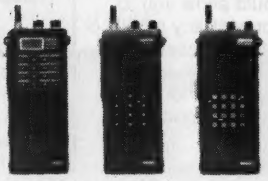

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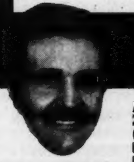

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THINGS TO LOOK FOR *(AND LOOK OUT FOR)* IN A PHONE PATCH

- One year warranty.
- A patch should work with any radio. AM, FM, ACSB, relay switched or synthesized.
- Patch performance should not be dependent on the T/R speed of your radio.
- Your patch should sound just like your home phone.
- There should not be any sampling noises to distract you and rob important syllables. The best phone patches do not use the cheap sampling method. (Did you know that the competition uses VOX rather than sampling in their $1000 commercial model?)
- A patch should disconnect automatically if the number dialed is busy.
- A patch should be flexible. You should be able to use it simplex, repeater aided simplex, or semi-duplex.
- A patch should allow you to manually connect any mobile or HT on your local repeater to the phone system for a fully automatic conversation. Someone may need to report an emergency!
- A patch should not become erratic when the mobile is noisy.
- You should be able to use a power amplifier on your base to extend range.
- You should be able to connect a patch to the MIC and EXT. speaker jack of your radio for a quick and effortless interface.
- You should be able to connect a patch to three points inside your radio (VOL high side, PTT, MIC) so that the patch does not interfere with the use of the radio and the VOL. and SQ. settings do not affect the patch.
- A patch should have MOV lightning protectors.
- Your patch should be made in the USA where consultation and factory service are immedately available. **(Beware of an inferior offshore copy of our former PRIVATE PATCH II.)**

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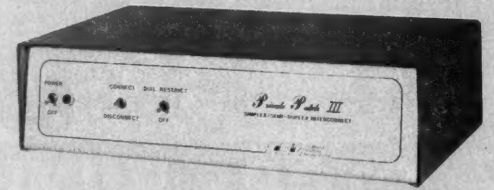

The telephone is the most powerful mode of communications... PRIVATE PATCH III gives you full use of your home telephone from your mobile and HT radios!

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PRIVATE PATCH III frees you from memberships, cliques and other hassles common to many repeater autopatches. You can call who you want, when you want and for as long as you want. You can even receive your incoming calls!

VOX . . . the right choice!

VOX based phone patches offer many performance and operational advantages over the sampling method. These include operation through repeaters, compatibility with any radio, no lost words or syllables, greater range, smooth audio free of continual noise bursts, etc., etc.

Most amateurs are not aware that the competition's top of the line patch is VOX based. (You know . . . the $1000 model they enthusiastically call **"our favorite commercial simplex patch"** on page 3 of their SP brochure.)

PRIVATE PATCH III offers about the same capability, performance and features as their top model but is priced closer to their bottom of the line (SP) model!

So why settle for SP when top of the line costs little more?

To Learn more about PRIVATE PATCH III and the advantages of the VOX concept, call or write for our four page brochure today!

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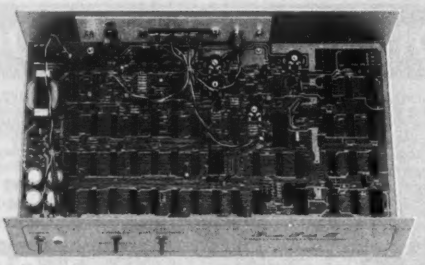

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SEPTEMBER 1986

ISSUE #312

A Rotatable *What?* 28

There's this 90-foot crank-up tower, see, and it has everything on it, from stacked 23-element yagis for 1296 MHz to a 3-element 40-meter monobander . . . but the wind load's too great to use a commercial rotator. The solution? Easy—put the 90-footer on a lazy Susan and spin the entire tower!

HF Antennas: All Bands, All Wire 32

The curse of coax is lifted! W0VM vanquishes the black snake with three 9-band antennas. The secret is the use of balanced tuned feeders, a technique all but forgotten by hams who grew up with RG-58U.

Watts My Line 36

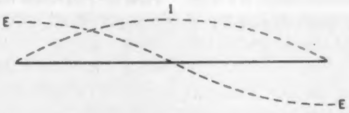
Comes a time when every ham is put to the test. In this case, a nonstandard transmission line had to be fabricated from the materials at hand, a task made easier by the friendly computer. Use this Basic program to design your own lines: coax, parallel feed, shielded parallel feed, and microstrip.

Scaling the Wet Noodle 40

Bring your next antenna project down to size: Work with a scale model before you erect a full-size skywire.

Dishing It Out On 10 GHz 46

Construction techniques for building microwave feed systems and antennas, including the serendipitous "plastic baggie" dielectric resonator.

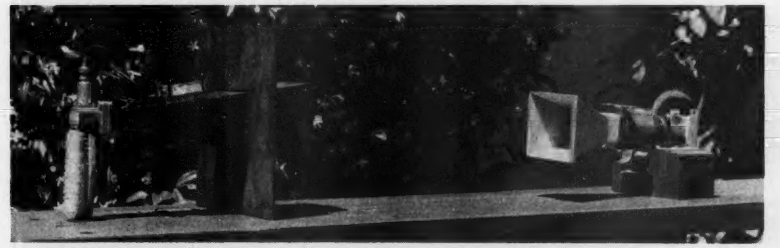


High and Dry 50

Here's a new twist on the old plumber's delight theme: WA2OLZ describes how to bring your rotator inside the house, and how to erect a 3-element tribander without using a tower.

The Ramada Radiator 52

A pack-it-up-and-take-it-with-you antenna that works on all bands and costs under $10 to build. (The title of this article came in a sudden flash of brilliance from Managing Editor KA1MPL, whose cousin is known throughout the Midwest as "Ramada Rudy.")



The Texas Tango Antenna 54

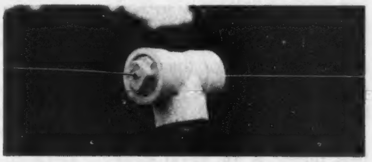
We toyed with the title "The Five O'Clock Shadow Doublet" for this little gem, because of the little black stubs of coax that act as tuned traps in this multiband wire antenna. It's a great way to add the new WARC bands to your favorite dipole.

Trap An Amazon Aerial 56

Another variation on the trapped dipole, this time with home-brewed capacitors. The prototype for this design was used extensively in the jungles of South America; you can expect years of use here in the states.

Resonant Wire Antennas 60

Get back to ham radio's roots with a resonant wire antenna—there's no feedline loss since there's no feedline.



The Lazy U Dipole 64

The continuing evolution of the VE7BS bent dipole. Basically a single-band antenna, the Lazy U could be just what you're looking for on 160 meters.

The 75m Laid-Back Quad 66

Okay, maybe the idea of a two-element quad pointing straight up seems a bit odd, but consider that, at least with rf, most of what goes up eventually comes down. (If nothing else it will keep your lawn free of snow in the winter.)

Extra copies of this issue are available for $4.50—send a check or money order to *73* Back Issues, WGE Center, Peterborough NH 03458-1194.

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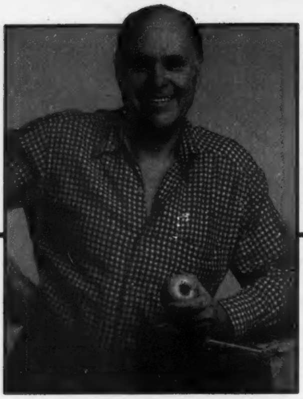
NEVER SAY DIE



GETTING THE WORK YOU WANT

You say you're not excited and raring to go when you go to work in the morning? If your work isn't fun, you're in the wrong work. If you're not getting to work early so you can get at it...if you're not one of the last out at night because you hate to leave, you're losing out on a lot of the fun of life.

Work is fun for millions of people. Work is misery and aggravation for millions more—millions who just have never stopped for a while to think things out. If you leave your life entirely to chance and make no effort to plan it, then you have no beef. Anyone so lazy that they won't make an effort to make life better for themselves should shut up and take life's beatings passively.

What's this got to do with amateur radio? A lot, good friend. Now, just the fact that you've managed to get your ham ticket sets you apart from the average schmo (Yiddish for a foolish or stupid person). However, if you're whining about the cost of ham gear or the cost of a *73* subscription, it's time for you to take stock of your life. If you're short of money you're not doing it right.

Considering all the potential amateur radio has provided you for developing a career—unless you Bashed your way in and really don't know diddly—you should be able to do very well. Electronic technicians are desperately needed today.

But no matter what your field of expertise...say, you *do* have some expertise, don't you? If not, that's a big part of the problem. If not, for heaven's sake take some aspect of amateur radio and become an expert on it. It isn't difficult. I've become an expert on NBFM, SSB, repeaters, RTTY, computers, and so on. If I can do it, so can you.

Once you're an expert you can use that to further your career. How do you know when you're an expert? Well, you'll know. It's when you can work from experience and facts rather than firmly held convictions. It's when you get published.

Speaking of being published ...as a good general rule, when you're changing jobs you'll find that each article you've had published in your field of expertise will bring you about $1,000 a year more in salary. I'll bet that got your attention!

Okay, let's say you've picked a career path where your experience in amateur radio will help you. Let's say you've become an expert on something...perhaps slow-scan television...or packet radio. Now you want to use that expertise at work. Once you find a company doing the sort of thing you're interested in, how can you get a job there?

No matter what job you want, if you know you're really qualified and that the firm will benefit by hiring you, you can get a job. I don't care if there are no job openings. I don't care if the firm has a hiring freeze. If you want to work there and you spend some time planning your approach, they're dead meat.

The simple, but least productive, way to get a job is to walk in and apply for it. If you've come at the right time they may have an opening. Fine, but unless that opening is just what you're looking for, you're going to be stuck doing something other than your dream job.

It's not all that difficult to get the job you really want, whether the firm knows it needs you or not. All

Continued on page 10

SS GRID BIAS
LINN K4PP

"We heard you have a ham radio outfit on board so we're going out of the way to a rare island from which nobody has ever broadcast!"

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144.0 144.1 144.5 145.8 146.0 148.0 MHz

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- 10 memory channels for frequency, mode, CTCSS tone, offset. Two channels for odd splits.
- All mode squelch, noise blanker, and RIT
- Easy-to-read analog S & RF meter
- Dual digital VFOs
- Semi break-in CW with side tone
- MC-48 16-key DTMF hand microphone included
- Frequency lock, offset, reverse switches
- Digitial Channel Link (DCL) option

Optional accessories:

- **CD-10** call sign display
- **PS-430, PS-30** DC power supplies
- **SW-100A/B** SWR/power meter
- **SW-200A/B** SWR/power meter
- **SWT-1** 2-m antenna tuner
- **TU-7** 38-tone CTCSS encoder
- **MU-1** modem unit for DCL system
- **VS-1** voice synthesizer
- **MB-10** extra mobile mount
- **SP-40, SP-50** mobile speakers
- **PG-2K** extra DC cable
- **PG-3A** DC line noise filter
- **MC-60A, MC-80, MC-85** deluxe base station mics.
- **MC-42S** UP/DOWN mic.
- **MC-55** (8-pin) mobile mic.

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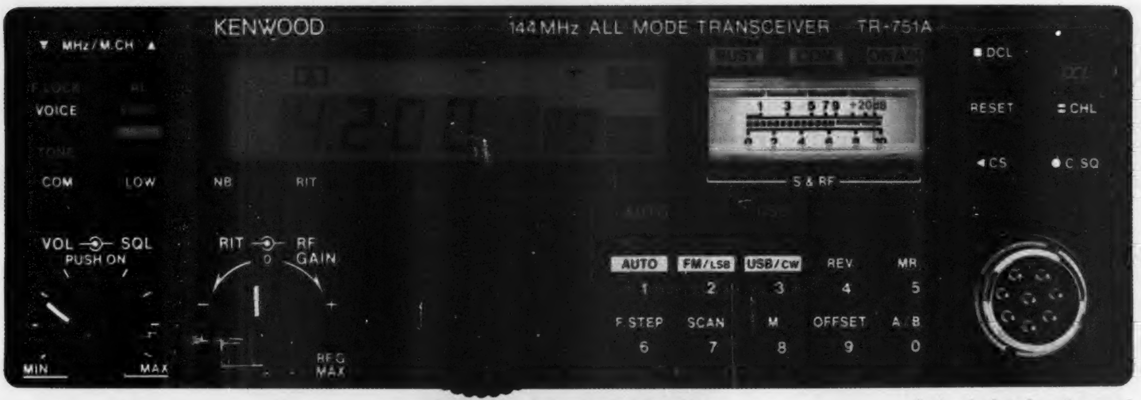
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REV 4
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Actual size front panel

TR-9500

70 CM SSB/CW/FM transceiver

- Covers 430-440 MHz, in steps of 100-Hz, 1-kHz, 5-kHz, 25-kHz or 1-MHz.
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- Automatic band/memory scan. Search of selected 10-kHz segments on SSB/CW.
- 6 memory channels.

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- **Repeater offset switch.** **TH-21AT/A:** ±600 kHz, simplex. **TH-31AT/A:** −1.6 MHz, reverse, simplex. **TH-41AT/A:** ±5 MHz, simplex.
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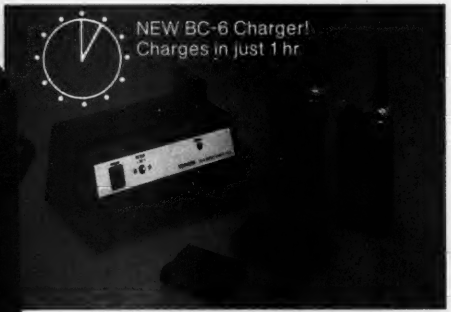
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- **PB-21H** NiCd 500 mAH battery
- **DC-21** DC-DC converter for mobile use
- **BT-2** manganese/alkaline battery case
- **EB-2** external C manganese/alkaline battery case
- **SC-8/8T** soft cases
- **TU-6** programmable sub-tone unit
- **AJ-3** thread-loc to BNC female adapter
- **BC-6** 2-pack quick charger
- **BC-2** wall charger for PB-21H
- **RA-8A/9A/10A** StubbyDuk antenna
- **BH-3** belt hook

TH-series transceivers shown with optional StubbyDuk antenna. TH-31AT shown with PB-21H.
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QRX . . .

EDITED BY PERRY DONHAM KW1O

220 Try

ANOTHER ATTEMPT to garner space on the amateur 220-MHz band has been made by the **Association of Radio Reading Services (ARRS)**. The ARRS is a volunteer organization that currently uses commercial FM subcarriers to broadcast text to the reading-impaired. Recent changes in the rules governing subcarrier use make it easier for broadcasters to deny space to groups such as the ARRS; the remaining stations are charging more and more for the use of their transmitters. The ARRS is asking the FCC to set aside ten 50-kHz channels in the amateur 220-MHz band for the reading service. Transmitters would be limited to an output of 1,000 Watts, and antenna height would be restricted to 1,000 feet. The allocation would be primary, with amateur radio coexisting on a secondary, noninterference basis. In an interview published in *220 Notes*, Robert Watson W0YOC, one of the authors of the proposal, said that the idea to use 220 MHz was originally put forth by the NTIA, a group currently involved with the FCC in a joint study of the future of the 220-MHz band. Watson went on to say that the ARRS had conducted an informal survey of the level of amateur activity on 220 MHz, and that on the basis of that survey felt that the ARRS and ham radio could share spectrum. The ARRS feels that theirs is a service very similar in nature to the public-service role played by amateur organizations. The ARRS proposal (RM-5434) joins the growing list of petitions seeking space on the 220-MHz band, including PR Docket 86-161, the Novice Enhancement package. No action is expected on any of the pending petitions until the joint FCC/NTIA study is completed. PR Docket 86-161 should be acted upon before year's end, but only the 28- and 1,296-MHz portions will become effective . . . it could be years before the situation on 220 MHz is straightened out. If you'd like to comment on the ARRS proposal, you can file informally by sending a letter, or you can file formally by sending an original and 12 copies to the commission. If you opt for a formal comment, you also need to send a copy to J. Brian DeBoice, Cohn and Marks, 1333 New Hampshire Ave. NW, Suite 600, Washington DC 20036 (DeBoice is the attorney for the ARRS). You'll also need to include an affidavit with your material stating that you have forwarded copies to Cohn and Marks. The FCC's address is 1919 M Street NW, Washington DC 20554. (An example of the format to use appeared on page 89 of the July, 1986, issue of *73*.)

Ten Matters

BOB HEIL K9EID has proposed changes in the ten-meter FM band plan. The new plan calls for ten repeater pairs on 400-kHz splits and 20-kHz spacing with inputs from 29.100 to 29.280 MHz. 29.300 to 29.400 would be used only for simplex contacts, while 29.400 to 29.500 MHz remains reserved for OSCAR mode-A downlinks. (Eventually, mode-A use will be discontinued, and the space used for simplex operation.) Bob suggests a 50-Watt limit in the repeater subband. Things are pretty quiet on ten meters right now, but as cycle 22 picks up steam, the need for some sort of spectrum management will become more urgent. One of the biggest changes to the present structure made by Bob's proposal is the elimination of half of the AM window (29.000 to 29.200). If you have any thoughts on the matter, please send a note to Bob at PO Box 78, Marissa IL 62257, with a copy to Iowa Repeater Council president Dennis Crabb WB0GGI, 1306 4th Avenue North, Denison IA 51442.

Bird Books

TWO POPULAR BOOKS on commercial satellites have been updated. The second edition of ***The Hidden Signals on Satellite TV*** adds 60 pages of text and two new chapters covering Ku-band reception. The book is available from Universal Electronics, Inc., 4555 Groves Road, Suite 3, Columbus OH 43232. Weather-facsimile fans should pick up the new third edition of Dr. Ralph Taggart's ***The Weather Satellite Handbook***, now published in a plastic binder to make updates simple. This is about the best book going and covers everything you need to know about receiving WEFAX. You can get a copy right from Ralph—send $12.50 to Ralph's callbook address. Ralph has agreed to conduct a weather-satellite column in *73*; it'll be starting next month.

Radio Cops

A NEW VERSION of the Electronic Communication Privacy Act has been unanimously voted out of the House Judiciary Committee. The revised bill, HR-4952, clearly stipulates that it is *not* a crime to simply receive a signal, whether the reception was intentional or not. The language seems to be a little closer to the existing privacy statute which forbids divulging the content of a radio signal. There *are*, however, some pretty puerile items in the bill. Certain types of communications (including cellular telephones, encrypted services, and common-carrier transmissions) are considered "protected" under the bill since they are not designed to be accessible to the general public. HR-4952 spells out the fines and sentences to be imposed upon anyone who tunes in to this type of radio signal. It's easy to look at something like this and laugh . . . the whole idea is really ludicrous. *But*, there is an *enormous* amount of pressure from the communications industry, especially the cellular people, to get this bill pushed through Congress. There is a very real chance that they will succeed. Obviously, if the bill passes, there won't be radio police running around with DF gear—the provisions of the legislation would be extremely hard to enforce. Still, the idea that, for the first time, the government would tell us what we can and cannot listen to should be enough to get you to write your representatives in Washington. Put down the magazine and do it *right now*. It's been about two months since this story was written, and a lot can happen in two months . . . let's hope it's not too late.

Kiwi Flys By

73's own Kiwi correspondent, **Des Chapman ZL2VR**, traveled through scenic Hancock recently to visit the palatial editorial offices of *73*. Des (pronounced Dez) arrived as we were in the middle of an internal reshuffling of desks—in other words, the normally eighth-wonder-of-the-world-like editorial section looked as if an earthquake had just hit, with the epicenter being the desk of KW1O (who was conveniently out of town). We repaired to the Hancock Inn to wash away the dust of the road and get acquainted in person. Des is our kind of DXer, a man who would rather talk to someone on the air than "work" him. We learned much in a short time about New Zealand—not politics or the like, but more practical information like how to buy a round of beer ZL style (just say "It's my shout."). Des has been a faithful provider of ZL news for our *73* International section for a number of years, and it was a pleasure and an honor to meet him in person. Thanks, Des, for your fine work, and when you come this way again, remember that it's our shout.—*KA1MPL.*

Elmer Bank

TWO NEW BANKS have been opened by the **Westchester (NY) Emergency Communications Association**. The programs are designed to help newly licensed hams find their way around their new hobby. The Equipment Bank is a stockpile of surplus gear monitored by Bob Steinberg WA2KHR. Bob contacts new hams in the club to determine what they need to get on the air; when a need matches something in the bank, the equipment is loaned for 90 days. Once a station is set up, new amateurs can contact Adam Weiss WA1WMZ at the Elmer Bank to get paired with an experienced ham who gives the newcomer personal attention and aid. If you'd like more information about WECA and their banks, drop them a note at PO Box 131, North Tarrytown NY 10591.

Fake Out

DON'T BE SURPRISED if in October you hear enormous pileups on what seems to be a U.S. Extra-class license. From October 20th to the 25th, the **Radio Club Mar del Plata** will operate **AZ1D from Trinidad Island** during the ninth IARU Region II conference to be held in Buenos Aires. Trinidad Island is situated about 30 miles south of Bahia Blanca on the Argentine coast. On CW, look for AZ1D on 3.510, 7.005, 14.020, 21.020, and 28.020. On SSB, the operation will be around 3.690, 7.090, 14.200, 21.300, and 28.600. The group also plans to be active on six and two meters (50.110 and 146.52/144.30) and on OSCAR 10 (if it's working).

Time Tip

IF YOU'RE HAVING TROUBLE receiving WWV, you can get accurate time information by calling the National Bureau of Standards on the landline at (303)-499-7111. Don't forget that at 18 minutes past the hour, WWV transmits current and predicted propagation conditions.

I Like Eico

JOHN HODGE called to say that he loves his Eico three-band transceiver, and also that he had successfully tracked down Eico in Hampstead, New York. I had thought that Eico was belly up, but according to John that's not the case—in fact, he placed an order for several items he needed for his rig. Their address is 113 Fulton Avenue, Hampstead NY 11550, or you can call them at (516)-485-1331.

Deeply Asleep

OSCAR 10 IS IN DEEP DOO-DOO. The memory fault that crippled the satellite earlier this year has gotten worse, and attempts to write around the damaged areas have not been successful. Speaking with the *Westlink Report*, AMSAT president **Rip Riportella WA2LQQ** said that the engineering team working on the problem "had been looking for reasons to be optimistic [for the craft's recovery], but frankly had not found any in recent days." As reported last month, the newest Phase 3 satellite is on the ground, waiting for a launch opportunity on the European Space Agency's new Arienne-4 booster. ESA's space activities were squelched when an Arienne-2's third stage failed to ignite, causing the destruction of the booster and the $55 million Intelsat V satellite. Launches will resume as soon as the accident has been fully investigated—some sources fear a two- or three-year delay, although AMSAT is confident that Phase 3C will be launched in 1987. In the meantime, bird watchers will have at least one new spacecraft to play with, the Japanese-built JAS-1 scheduled for launch on July 31; rumors also abound concerning the imminent launch of two new circular-orbit Soviet satellites, RS-9 and RS-10.

Check Writing

A FEW PEOPLE have been asking about the Reader Service cards that appear in each issue of *73*. Here's how they work: When you see an advertisement for a product that you would like to receive more information about, look in the ad for a small check mark followed by a number (it's usually close to the company's name). This is the number to circle on the Reader Service card. We have a pair of wonderful ladies here who'll send your name and address on a mailing label to the manufacturers you've selected. Pretty simple, eh? While you're in the filling-out mood, complete the Product Report Card and the Feedback survey and drop them in an envelope along with your QSL order and your check for $19.97 (for a one-year subscription); you could also toss in a letter to the editor, and get the maximum value from your 22-cent stamp.

Help

HELP WITH THIS MONTH'S QRX came from The *Westlink Report*, The *W5YI Report*, *220 Notes*, *Sweden Calling DXers*, and Rich Moseson N2BFG. Please send your news bits and pictures to *73* Magazine, 70 Rte. 202 N., Peterborough NH 03458, Attn. QRX.

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All day Friday and Saturday

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ALL WE NEED TO COMPLETE OUR CONSTRUCTION PROJECT IS YOU! How do you become a part of this exciting new chapter in amateur radio history? Just send us this form, call your travel agent or fire up your mobile rig, and plan to BE THERE!

GENERAL INFO: Plan to travel on Thursday. Exhibits and forums will be open 8 a.m.-5 p.m. Friday and 8 a.m.-4 p.m. Saturday. Awards banquet will be at 8 p.m. Saturday.

REGISTRATION INFO: Every person taking part in the HAM/WEST activities must be registered. Advance registration is $12 before October 24 ($15 at the door) and includes prize tickets and admission to all HAM/WEST activities except the banquet. It is not necessary to be registered to purchase tickets for the Saturday evening awards banquet. Flea-market sellers must be registered; outdoor spaces measure 16'x20' (two parking spaces). Born in 1966 or later? Request complimentary "admission-only" tickets (no prizes) at the door. And — there's no fee for VEC exams taken at the convention!

HOTEL INFO: To guarantee your room, you must **make your room reservations directly with HAM/WEST**, either on this form or by phone (if charging to a credit card), and **make payment in full before October 1, 1986.** Reservations not paid by that time will be accommodated on a *space-available basis only.* Call HAM/WEST at 702-361-3331.

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How many persons will stay in this room? ( ) One ($55.00/night) ( ) Two ($55.00/night) ( ) Three ($65.00/night) ( ) Four ($75.00/night)

How many beds do you need? ( ) One double bed ( ) Two double beds ( ) One king-size bed

Any special requests? ____________________

Amount for room $__________ ( ) **Check or money order enclosed**

Plus 7% room tax $__________ ( ) **Charge to credit card #** __________ Exp. date __________

Advance reg., $12/person $__________ Print your name __________ Phone ____/______

Banquet, $20/person $__________ ( ) M/C ( ) VISA

Flea market, $20/space $__________ ( ) AMEX Authorized Signature __________

Total amount $__________ Note: We will bill your credit card account in full when your registration form is received.

HAM/WEST, P.O. Box 19675, Las Vegas, NV 89132, 702-361-3331

NEVER SAY DIE

from page 4

you have to do is create your job . . . defining it to fit your abilities. How? Well, if you do some homework . . . and presumably, if you really want to work for the firm, you must know something about it . . . if you find out some weaknesses the firm has . . . there may be a weakness you can solve for them.

Make sure of your facts, then go to the boss . . . not the personnel department . . . and show him (or her) how you will be able to help the firm to make more profits. Your salary will be unimportant if you can solve a problem for the boss. Make sure you're on firm ground with your recommendations.

You can find out a lot about a firm by reading the local papers . . . reading the trades . . . and then by getting to know some of the people working there and getting their support. They'll know where the problems are and what's been done so far to solve them. They'll know where you might fit in to make things better.

Once you're in and effective, you want to keep your eyes open for managerial opportunities. If you've been doing your homework . . . learning about management, advertising, finance, planning, computers, spreadsheets, writing, speaking, etc., your combination of management and technical skills will put you into a position to make real money. And management is where the money is.

If you prefer to be an entrepreneur, you still are going to need both management and technical skills. Indeed, 90% of small businesses fail in the first five years for a lack of management skills. Management is no more intuitive than engineering. Management takes learning and practice.

I've had a lot of hams write to me or approach me at hamfests and say they'd like to work for me. I can't think of any yet who came to me with a plan for making money for Wayne Green Enterprises. They've all had in mind making money for themselves and it really never occurred to them that if they make money for me, they'll make money, too.

When a prospective employee starts asking me about the benefits, I know he's thinking of vacation days, sick leave, and all those things that are going to cost me money without providing me with any benefits. What I want to know is what are the benefits I'll get by having this person working for me. Will he make *73* more fun to read and thus perhaps bring us more readers? Will he be able to help us put out better subscription solicitation letters and thus increase circulation? What are the benefits to *73*? I can't remember anyone ever giving this any thought when they were applying for work.

When you go for a new job, are you more interested in what you can do for the firm or in what kind of insurance plan they have for you? Do you worry about how often they review people for salary adjustments or how you can bring them more business? You know the answer . . . and I'll bet it's why you're not making nearly as much as you could be.

One of the most basic elements of salesmanship is pointing out the benefits of what you're selling. The most important product you have to sell in the whole world is yourself. So what are the benefits you provide? Once you start thinking this way you'll start seeing ways you can benefit your company more. You may see opportunities to learn more about something and help your company that way. If you think in terms of benefitting the company instead of benefitting yourself, you've made the first major step toward being a real success in life.

We have one of the best places in the world to work here at WGE . . . great people . . . the most modern magazine publishing plant possible . . . enormous growth potential . . . good pay . . . one of the most beautiful parts of the country in which to work and live . . . a smoke-free environment . . . opportunities to learn and develop skills in current or new projects . . . yet even here we have some people who are wasting their lives by not taking advantage of what's available. How many of the opportunities available to you where you're working are you really using?

I had one chap we hired to start a new business for WGE. He was hired at a very good salary, we bought him a home, gave him assistants and a car. Despite all urging, he spent months planning and got nothing of benefit done. When our patience finally ran out and he was replaced by a new one-man department which promptly got the business going, he was furious with me . . . instead of with himself.

Many of our activities in amateur radio provide us with the expertise to do commercial work. Hams who get into building and repairing of ham gear are naturals for two-way businesses. Hams who get into computer repairs are desperately needed by computer repair outfits. I've recently mentioned the potential in home and business security firms.

Many ham developments can be escalated into commercial products for the entrepreneurially minded. A recent application of slow scan turned up at the Chicago Consumer Electronics Show . . . a unit with a camera and monitor which sends pictures over telephone lines. How long before we start seeing commercial packet-radio applications?

Not a few hams have escalated their interest in OSCAR into home satellite sales. That business is in a turmoil right now due to the recent scrambling of signals, but I suspect we'll see some creative solutions to that . . . probably from a ham.

Maybe you should flag this part of my editorial and re-read it again in a few weeks.

THE AGONY OF SLOW SCAN

Slow-scan television looks like it sure should be fun. Imagine, being able to see snapshots of the chap you're contacting . . . a picture of his shack . . . his house. Wow!

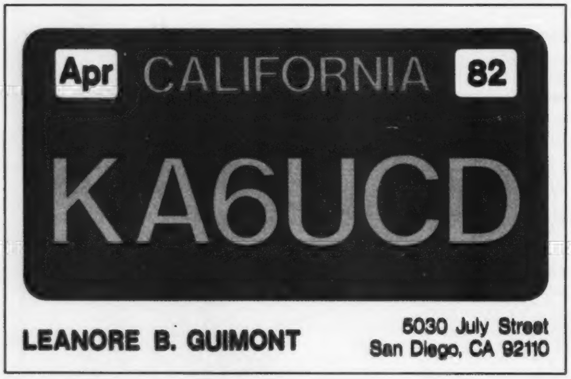
Well, of course there are some downside aspects of slow scan, but there are a lot of wows too. There seem to be enough fun aspects to SSTV to keep the 14.230–40 channel fairly active every day.

I got interested in slow scan in its early days, about 15 years ago. I seem to enjoy pioneering on the ham bands . . . getting very active on NBFM in 1946, RTTY in 1949, repeaters in 1952, and so on. The camera and monitor for slow scan aren't exactly for paupers, so it isn't a branch of the hobby one gets into casually.

With the camera and a monitor I was in business. Of course I already had a fairly substantial 20m station . . . as key an element in making dependable SSTV contacts as in any other. I recommend the usual sideband transceiver, kilowatt amplifier, and three-element (or larger) beam up 75 feet on a tower. The usual for DXing or contests.

I set up a restaurant menu board on an easel so I could focus the camera on it. On this I put my call, with a place for calling CQ or confirming the call of the chap I was working. When I'd make a contact, I'd get out the call letters of the chap I was working to snap on the board. That was my QSL.

I also set up a small 35mm projector and a video converter unit . . . a small mirror with a frosted screen for projecting slides so you can put them on video tape. I'd swing my camera from the menu board to me sitting at the operating desk to the converter for slides of the shack, the house, my



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QSL OF THE MONTH

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◄133

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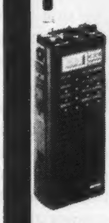

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HF XCVR/General Coverage Receiver.

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Small, light HTs for 2m or 440 MHz. 10 memories and scan functions.

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NEW FT-727G
Dual-band handheld for 2m/440 MHz

Ask for Package Quotes on Radios/Accessories & Antennas/Towers

daughter Sage, and so on. I worked up quite a series.

Unless you're set up for color SSTV, you'll do better to buy some positive black and white film and shoot your material in black and white. Color slides don't do well when sent in black and white. The gray scale is screwed up.

Being a recognized amateur radio fanatic, I naturally went on to get a second camera so I didn't have to get up and swing it between frames.

There are two major problems with slow scan. One is the amount of thought and work it takes to come up with an interesting program to send. Remember, you can send your program to each chap you work only once. The next time he's not going to be interested in seeing the same old stuff again. So what do you do for an encore? Along about the third contact with a station you're finding the pressure for new programs getting to you. You're running out of ideas. . . and then soon you're running out of people who will call you. Next you run out of hams who will even admit they can hear you.

The second misery is the other chap's programming. How many times do you want to sit and watch pictures of his kids, his dog with earphones on (DX hound. . . get it?), his messy shack, and, perhaps worst, fat, ugly him? It's fortunate there are so many SSTVers, so for a few weeks you have a good selection of chaps to contact. But then it begins to thin out. . . the same stations. . . the same pictures as you tune up and down the band. Hmmm, Playboy centerfolds, so that has to be that YV5. Old girlfriends and pinups. . . that's the W4 in Miami.

I once ran a slow-scan program contest and got quite a number of creative programs submitted on cassettes. I put the best of them together on one tape and made it available. It wasn't exactly a profit center for the magazine, but it did pay for the trouble. . . and I think it helped give slow scanners some desperately needed ideas. With some urging I might try another slow-scan program contest. . . any enthusiasm? It'll be interesting to see how much change we've had in the ten years or so since the last contest.

With over a hundred countries available on slow scan, the program problem is not an immediate one. Indeed, if you stick to DXing and don't play around with lengthy programs, it isn't a problem at all. That's like beefing about the lack of discussion topics brought up during contest or DXpedition contacts.

I expect there are many readers who are interested in knowing what's going on with color slow scan. . . with high-definition slow scan. Let's see some articles bringing us up to date on the slow-scan frontiers.

HOW TO BE A MISERABLE ROTTEN FAILURE

Surrounded, as we are, on every side by miserable rotten failures, who needs a lecture on how to achieve this dubious undistinction? Yet, at any time in life, no matter how misspent. . . even a life dedicated to the pursuit of the religious ecstacy of working DX, probably second only in galactic importance to a lifetime spent memorizing baseball statistics . . . it is possible to firmly grasp one's bootstraps, pull one's self out of the muck of life, and join the select fleet few who are successful in more than their own eyes.

Without getting into hair-splitting definitions of success and failure, let's use the usual yardstick. . . dollars. Dollars you control, whether you own them or not. This will get us away from personal judgements. . . such as my feeling that anyone who really cares whether a *73* subscription costs $20, $25, or even $30 a year can hardly be classed as a success. Is the magazine fun to read? Okay, I want it, here's my credit card.

If you want to drive a crummy car. . . fine. . . but if you *have* to, that's something else. That's avoidable.

Okay, let's get right to the heart of what makes someone successful. . . other than luck. And even luck can be loaded. When people tell me how lucky they think I am, I say sure, and the harder I work, the luckier I get. We sure have a screwed-up language. . . and some of the screw-ups can give us major problems. Like that term "work." We use that to describe what we do to earn money, using the same term whether we're enjoying what we do or hating every minute of it.

Sure, we do have words to differentiate, but we're lazy about our language. . . to some degree. But even William Safire isn't likely to say he's going to drudgery. For those of you who don't read much, Safire writes about words.

Well, enough of that. . . now, let's take a look at what separates the sheep from the goats. . . the men from the boys (of all ages). We can even get more fundamental than that. What separates man from all other life on Earth? How did man come to win out? We certainly aren't the strongest animal. A short listen on two meters in Los Angeles should convince even the most stubborn that we're surely not the smartest animal. So how'd we win?

We won out by wearing 'em down. There are many animals much faster than man, yet we're able to catch all of 'em in the long run. Man can outrun a horse, an antelope, and even a cheeta. 26-mile races are popular now. . . heck, Southwestern Indians used to have 100-mile footraces. We don't even make much of a deal of it when someone walks 3,000 miles across the country.

Fine, he's talking about winning marathons and I work in an accounting office. . . or sell shoes. The formula for success. . . the formula for failure. . . they're the same, whether you're selling shoes or winning a marathon. Most of us go through life, making our choices from what is handed us and griping about it. Few even bother to read books on how to be successful. But how can you expect to hit success if you don't even aim at it? Perhaps you've noticed that relatively few people really succeed.

Heck, everyone can't be a success, right? I'm not so sure. I do know that the more people who are successful, the more successful the country will be. For many years Americans made double and triple as much as people in most other countries. No more. Just as Great Britain had the world in its grasp a hundred years ago and now is heading rapidly toward being one of the poorest countries in Europe, so we're seeing America slipping from its pinnacle of power and success, which peaked in the 50s.

Your personal success or failure depends more than anything else on your persistence. Your failure to persist. . . plus that of 240 million other unpersistent Americans. . . adds up to America losing out to Japan in one industry after another. The fact that the Japanese are able to come to America, set up factories, and beat the heck out of American-run factories making the same products. . . beat 'em in efficiency, productivity, and quality. . . can't be ignored.

How can we apply this concept to our own lives? What can we do differently so we can start being winners? Let's take the accountant as an example. The choice for him (or her) is to go to work every day, do things the same way as he's always done, go home, watch television or go to dinner and a movie. . . and back to work again the next day. He might even substitute a couple hours on a 75m net for some television. . . or a couple nights a week bowling.

The persistent accountant is going to be looking for accounting courses he can take to learn some specialties. He'll be reading the latest books and accounting magazines. He'll be working his way into the business management of his firm. He'll be watching for ideas that he can use with his clients to save or make them money.

The enthusiastic accountant will be checking out many computerized accounting systems to see which is best for his clients . . . which is easiest for them to use. . . which can save them more money. He'll set it up and train them to use it. Different types of businesses call for different computer systems.

With some education in financing, he might help his clients get money—arrange bank loans, set up stock and bond deals, or find investment groups and put 'em together. Soon our accountant is attractive as a chief financial officer for a corporation. . . and from there, if he learns more about handling people and the technology of his business, to president.

Our ancestors had to outlast antelopes to get a good dinner. Today we get our dinners with education instead of running. Running we do just to keep our bodies in shape so we can enjoy life. . . but it's still the long haul which wins.

You know, if we set good examples for our kids. . . if we show them with our own lives that persistence wins. . . I'll bet we'd have far fewer kids griping about how stupid it is to learn the code to get a ham license. Think about it. . . what have you done to set a good example for your kids? Are you teaching them with a six-pack and a bag of potato chips as you watch sitcoms. . . or by taking night and mail-order courses?

If you persist in learning more and more about what you're doing, you'll be surprised at how quickly you sail far beyond everyone else around you. When I started *Byte* magazine in 1975, I didn't

Continued on page 82

Spectrum Repeater/Link

High Performance Boards & Sub-Assemblies

These are professional "Commercial Grade" Units—Designed for Extreme Environments (−30 to 60° C.) All Equipment Assembled & Tested.

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New FL-4 UHF Helical Resonators

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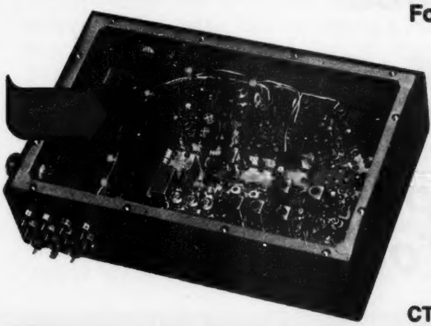

COMPLETE SHIELDED RCVR. ASSY.

VHF & UHF Receiver Boards

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Complete Receiver Assemblies

- Rcvr. Board mounted in shielded housing.
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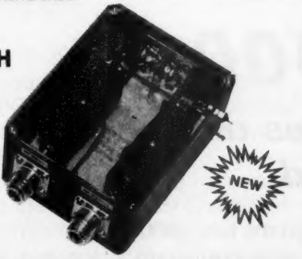
- As used in the SCR 1000/2000X. Ready to drop into your system!
- UHF Rcvr. Assy. Now Available w/Super Sharp FL-4 Helical Resonators. Greatly reduces IM & "out of band" interference!

FL—4H



Receiver Front-End Preselectors

- **FL-6: 6HI Q Resonators with Lo-Noise Transistor Amp (2M or 220 MHz)**
- **FL-4H: 4HI Q Helical Resonators & Lo-Noise Tr. Amp. in shielded housing. (420-470 MHz)**
- **Provides tremendous rejection of "out-of-band" signals w/out the usual loss!** Can often be used instead of large expensive cavity filters.
- Extremely helpful at sites with many nearby transmitters to "filter-out" these out-of-band signals.

Call or Write for Data Sheets

ID250A CW ID & Audio Mixer Board

- **Improved! Now includes "audio mute" circuit and "Emergency Power ID" option.**
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- Many other features. Factory programmed.

CTC100 Rptr. COR Timer/Control Bd.

- Complete solid state control for rptr. COR "Hang" Timer, "Time-Out" Timer, TX local & remote Shutdown/Reset, etc.
- Includes inputs & outputs for panel controls & lamps.

Repeater Tone & Control Bds.

For SCR1000/4000 & CTC100/ID250 only

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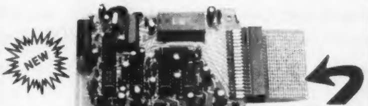

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TTC300 TOUCH TONE CONTROLLER

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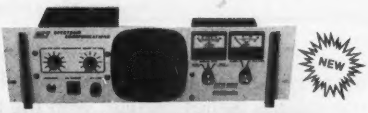

SCR 500 VHF/UHF COMMERCIAL LINK/CONTROL RECEIVER

- SCR200A or SCR450A rack mounted
- Available with or without meters and power supply
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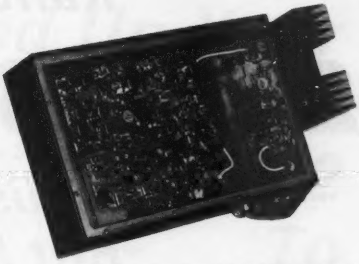


Improved SCT410B Transmitter Assy.

SCT110 VHF Xmtr/Exciter Board

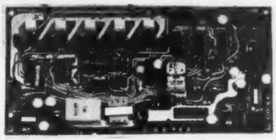
- **10 Wts. Output. 100% Duty Cycle!**
- Withstands High VS WR
- True FM for exc. audio quality
- Designed specificially for continuous rptr. service. Very low in "white noise."
- Spurious – 75 dB. Harmonics – 60 dB.
- With .0005% precision grade xtal.
- **BA-30 30 Wt. Amp board & Heat sink,** 3 sec. L.P. filter & rel. pwr. sensor.
- **BA75 75 Wt. unit also available**

SCT110 Transmitter Assembly

- ***SCT110 mounted in shielded housing***
- Same as used on SCR 1000 & 2000X
- Completely assmbld. w/F.T. caps, SO239 conn.
- 10, 30, or 75 Wt. unit.

SCT 410B UHF Transmitter Bd. or Assy.

- Similar to SCT110, 10 Wts. nom.
- ***Now includes "on board" proportional Xtal Osc./Oven circuitry for very high stability!***
- **BA-40 40W. UHF AMP. BD. & HEAT SINK**



SCAP Autopatch Board

- Provides all basic autopatch functions
- Secure 3 Digit Access; 1 Aux On-Off function, Audio AGC; Built-in timers; etc. Beautiful Audio!
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¡ Se habla español !

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Kantronics Introduces

2400 BAUD PACKET*

Not Just For All Computers But For All TNC's Too!

WHY 2400 BAUD?

Packet channels are congested, and faster is better. So Kantronics has designed a 2400 baud PSK (phase shift keying) modem and included it in an all new KPC-2400. In addition, we are making this modem available in PC-board form to add to your TNC-1 or TNC-2, cables included! If you have a KPC-1 or KPC-2, we'll take it in trade for a new KPC-2400.

Since October 28, 1982, the rules have allowed for baud rates up to 19.6K. Of course, we've all been operating at 1200 baud with Bell 202 (1200 baud) standard tones. However, the bandwidth of our radios is fully capable of running up to 2400 baud, giving us congestion relief. Our phase shift modem (PSK) takes advantage of the bandwidth available and the reasonable linearity of the audio channels, and it is designed with the V.26TER CCITT specification in mind. To add to your TNC or trade for a new KPC-2400, see facing page.

KPC-2400
POWER
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KPC-2400

All the Features of KPC-2 Plus 2400 Baud

KPC-2400 Features

- AX.25 version 2 software
- Supports multiple connects
- All EPROM software is Kantronics written and U.S. copyrighted
- Advanced software HDLC, eliminating expensive chips
- In-house programmers/engineers
- In-house service representatives
- Periodic updates —we keep you on the air

When we set out to design the KPC-2400 ™, we wanted it to be compatible with existing units, and it is. The KPC-2400 features both the KPC-2 modem for 300 baud HF and 1200 baud VHF work, and a new phase shift keying (PSK) modem for 2400 baud operation. All modes are software selectable with HBAUD command!

In addition, we've retained the RS-232/TTL jumper for easy direct interface to PC compatibles or the VIC/C-64 series. Hence, with the KPC-2400 you get HF, VHF, and 2400 baud packet with all computers that have a serial port, all in one!

The KPC-2400 of course, retains the version 2 software with multiple connects, and we've included an onboard memory diagnostic routine too.

Suggested Retail $329.00

Speed Up Your TNC-1 Or TNC-2 To 2400 BAUD*

Speed up your local area network with the new *2400 TNC Modem™*. The 2400 TNC Modem is a PC-board that mounts directly above your existing TNC PC-board. By adding the 2400 TNC Modem to TNC-1 or 2, you gain 2400 baud while retaining 1200 baud operation, switch selectable.

Two 2400 TNC Modems will be available—one for TNC-1's, and another for TNC-2's. If you purchased a TNC-1 or TNC-2, manufactured or kit version, the 2400 TNC Modem should be compatible. If you have a home brew case, the installation may require case modification.

The 2400 TNC Modem will be available in late June. You may order the 2400 TNC Modem through a Kantronics dealer or directly through Kantronics, using check, money order, Visa or Mastercard. *Suggested Retail $149.00 (includes shipping).*

Trade In Your KPC-1 Or KPC-2 For a New KPC-2400

That's right—Now you can trade in your Packet Communicator (KPC-1), or KPC-2, and for just $149.00, you'll receive a NEW KPC-2400!

It's easy. All you have to do is fill out the KPC-2400 *EXCHANGE SCHEDULING FORM*, and mail it to Kantronics with check, money order, Visa or MC number. You'll be scheduled for exchange and notified by mail when to return your KPC-1 or KPC-2 to Kantronics. Once we receive your unit, a new KPC-2400 will be shipped directly to you.

You may also schedule your exchange by calling the Kantronics order desk and giving your Visa or MC number. Just call (913)842-7745 between 9-12, 1-4 (Central Standard Time) Monday-Friday, and we'll take it from there.

To guarantee a quick turn-around time, Kantronics is *scheduling ALL exchanges*, and assigning authorization numbers. Any unit returned to the factory without prior scheduling and authorization number will not be given priority placement.

KPC-2400
EXCHANGE SCHEDULING FORM

To schedule your KPC-2400 exchange, please fill out the information below and mail this form, including $149.00 payment (shipping included) to **Kantronics, 1202 E. 23rd Street. Lawrence, KS 66046.** You will be notified by mail of your authorization number, and scheduled exchange date. **DO NOT RETURN YOUR UNIT WITH THIS FORM.** This form is being used to SCHEDULE returns.

When it is time to return your unit, please DO NOT SEND BACK ANY CONNECTORS, CABLES OR POWER SUPPLIES. Send back only the unit itself. Any cables, connectors, or power supplies received will not be returned. You will receive a new manual and a 9-pin connector with your new KPC-2400.

Name ______________________ Call Sign ______________
Address ____
City ________________ State ______ Zip ______________
Phone( ) ______________________ Date ______________
Unit to be exchanged (check one) ______KPC-1 ______KPC-2
Serial Number ____
Payment (check one) ______Check or Money Order
______VISA
______Master Card
VISA or Master Card Number ___________________________
Exp. Date ___________________________

Any unit returned to the factory without payment, authorization number and prior scheduling will not receive priority placement.

*KPC-2400 operates with a 2400 bits-per-second (BPS) data rate in the 2400 mode. The signal rate of 2400 BPS is derived from a DIBIT data stream operating at 1200 baud. Therefore, the 2400 mode may be used above 28 MHZ.

Kantronics
RF Data Communications Specialists
1202 E. 23 Street Lawrence, Kansas 66046 (913) 842-7745

100

LETTERS

HELL NO

All my life I have had a problem learning languages. I just can't seem to translate another mode of communication into good old English. This disability carried over into ham radio with having to learn the code.

The ARRL not only avidly adheres to the code requirement, but they demand you learn the code and take the same form of code test that "they took." For four years I struggled to pass the 13-wpm code exam. I bought tapes, took courses, got on the Novice bands and worked thousands of QSOs, but I still couldn't pass the 13-wpm test...that is until last night when I breezed through the 20-wpm test!

About two weeks ago, while practicing code with my C-64, I discovered that if I speeded up the characters to 20 or 25 wpm (but with 13-wpm spacing) I went from 50% copy to 100% copy. Delighted with this discovery, I called one of our ARRL-sponsored volunteer examiners and asked if I could take the test with 20-wpm characters and 13-wpm spacing. The answer I received left me with the impression that our ARRL VE could not walk and chew gum at the same time. He did mumble that I might try clearing it through the ARRL VEC in Newington.

I immediately got on the phone to ARRL HQ and asked to speak with the VEC. His answer was a flat NO. He went on to mumble something about someone called Farnsworth and the Farnsworth Method, but when queried about what this mystical method was he didn't know. When I pointed out that the FCC rules did not prohibit the test in this manner, his response was "well that's the way I took the test," and I should do likewise. I asked who his boss was and could I speak to him. I was told that he was the boss and that was that. I then asked who he took his instructions from at the FCC, and he finally responded Larry Wykard.

I called Larry Wykard at the FCC and asked him if the FCC had any objections to my taking the test with the faster character speed. I was told that as long as it came out to 13-wpm, he didn't care how fast the character speed was.

I then approached our local ARRL VE armed with the OK from the FCC. Not only was I rebuked severely but I was also told to take the exam as the ARRL provided it or get out. He refused to discuss the matter and said he took his orders from the ARRL and didn't care what the FCC said.

I took the exam as provided by the ARRL and flat flunked it. I couldn't copy 40% with the slow character speed.

I then learned that an outfit called W5YI could also give exams...and best of all there was a scheduled exam in two weeks in the next town. When I told the W5YI VE of my problem with the slow character speed, his response was, "What speed do you want the characters sent at?" No hassle, no argument, no problem. I went to the W5YI exam and breezed through the 20-wpm test. It took me about 20 seconds to fill out the answer sheet. The attitude of the W5YI VEs was more than cordial; they went out of their way to help those of us taking the exams. They gave us all the practice code we wanted and waited until all were ready for the test before beginning. They were the most polite and helpful group I have ever run into in ham radio.

About a month ago (before I knew about the W5YI VE program) the ARRL sent me their letter urging me to renew my membership. I was somewhat disgusted with the whole situation and the 13-wpm code test. I was seriously considering quitting ham radio, and I tossed the letter aside. Today I frantically searched for it, found it, and answered "HELL NO."

Jim Shook N4KIM/AG
Ocala FL

Jim, you can't blame the folks at the League...they can't help it if they're stuck with a sluggish bureaucracy. Just about every decision made at the ARRL is made by some sort of committee—a committee which then presents its decision to a board for a vote. Of course, the board needs time to weigh all of the consequences, and, after all, there's no need to just rush into things, right?

Groups like the W5YI VEC can be very accommodating since they're in business to help people get licenses, not to maintain a power structure.

Since you mentioned it, I'd like to point out that the best way to learn code is to start right out at the speed you want to use. If you want to copy 20 wpm, then learn what characters sound like at 20 wpm. That way your brain hears the sound and immediately associates it with a character without any further processing.—KW1O.

WHY THE WAIT?

"Please allow 6–8 weeks for delivery" and the paradoxical parenthetical expression "(We're computerized for speed)" somehow seem grossly inconsistent with your 12-page subscription mailing. I had the card filled out—which incidentally didn't fit the envelope provided—a check enclosed, and the envelope resealed, but became increasingly uneasy about the inconsistency, to me, between the handling of a new subscription and what you "say," and how you "say" it, in 12 pages. I read it all and don't believe I've ever read that much from anyone else who wanted something from me.

Why do most suppliers of mail-order items want 4–6 weeks, and you want 6–8 weeks, to get something delivered? Or to change a subscription address?

I'm sitting on my sealed subscription envelope for a while.

Preston B. Tack N6MXJ
Desert Hot Spring CA

Most mail-order houses will sell things to anyone who sends them money. Here at 73, we're a bit more discriminating—after all, we can't let just anybody read our magazine! Once we receive your application for subscription, it takes about 6 weeks to check you out with the FCC, your local radio club, and your third-grade teacher. (If you haven't heard from us in 6 weeks, start looking over your shoulder.)

As they say, many call, but few are chosen.—KW1O.

PRICE OF HAM

As a non-ham, I'd like to complain about the ticket prices charged at hamfests. It seems to me that the money should be used to cover a club's expenses in presenting the event as well as to make money for other club functions. However, much of this money is used to buy the prizes offered for the hamfest.

From what I've seen, the people winning the main prizes are those that already have a similar piece of equipment, and rather than selling the old set and keeping the new one, they try to sell the set they won.

Another thing about hamfests that bothers me is when a club states that if a non-ham's ticket is drawn, the club will not give him a transmitter if that is the prize. One club said it is their policy not to allow transmitters to be given to unlicensed people. I can think of lots of instances where a non-ham might want to do something with a transmitting rig, such as keep it for when he does get a license, use it as a receiver only, an XYL could give it to her husband, it could be donated to a club, and so forth. If I get a ticket to a hamfest with such a rule, I just put someone else's name on the ticket.

Another point I'd like to bring up is the cost of getting into a hamfest just to look at most of the same things I saw at the last hamfest. The charges for some hamfests to set up a table to sell are also excessive. Why can't they have a $1 or $2 admission and another $1 or $2 for setting up? I have gone to record conventions and gun shows that were extremely large, yet I was charged $2 at most for admission.

Monty Meier
Apple Creek OH

The most I've paid is $9, which I thought was a real rip-off. Most of the shows I've seen have been worth between $3 and $5...the value is directly related to the size of the flea market.

Restricting certain prizes to licensed amateurs is just ludicrous. A prize is a prize, guys. Besides, what better incentive is there to get a license than to be given a shiny new transceiver? If a non-ham wins, instead of making him feel like dirt, the club should do all it can to help the fellow get his ticket.

Do you know what the real problem is, Monty? It's that hams take their hobby too damn seriously. They're always worrying about little nit-picking rules and feeling self-important about their "hard-earned" licenses—it's no wonder that young people are turned off by such a pompous bunch. I guess that after 20 or 30 years, one forgets how much fun ham radio used to be.—KW1O.

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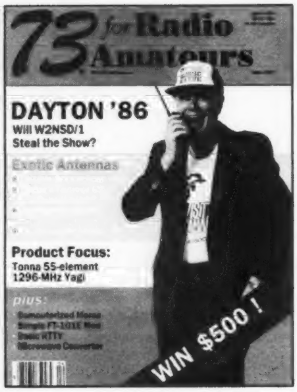
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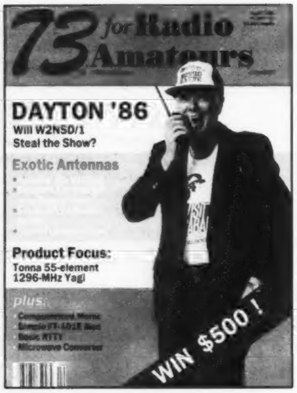
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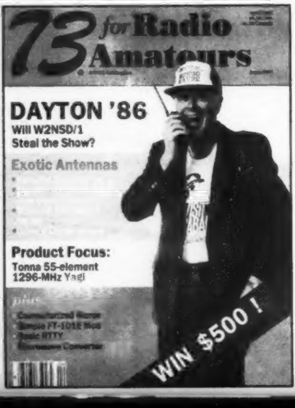
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I'M BACK!. . .WAYNE W2NSD/1

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4.) Will I be able to get 800,000 new hams licensed *per year* in China? I think I can—and you will want to read how I'm going to do it. I'll even tell you how to get such a program going in the U.S. We sure could use it!

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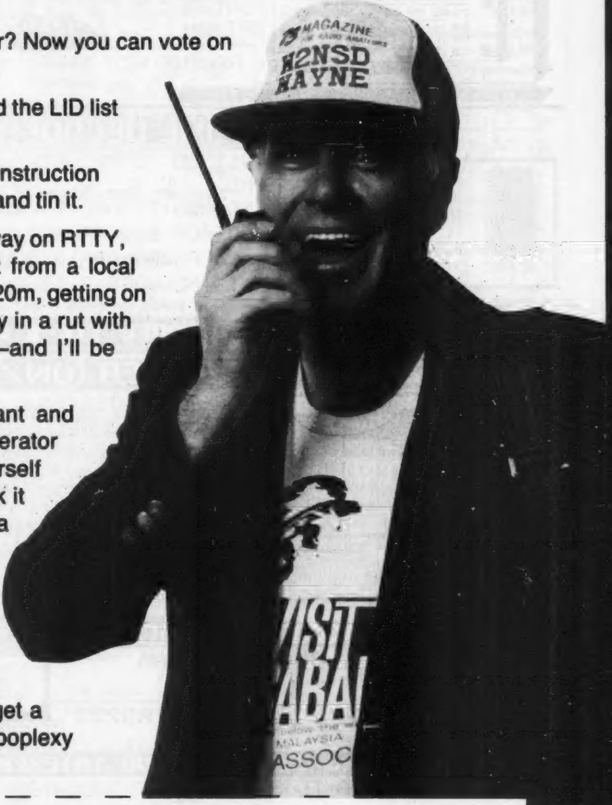
9.) I've forgotten what this was, but it was very important and persuasive. If I could remember it you'd call my 800 operator immediately with your subscription. You'll never forgive yourself if you miss out on this one. . . I remember that much! I think it had something to do with a whole lot of money—perhaps a free trip somewhere. Check *73* for the details.

10.) We're going to be reprinting some of the funniest ham humor from *73*'s sordid past. A medical checkup is recommended before reading.

11.) (bonus) Yes, I know *73* got pretty dull last year—well, well, I'm back and whatever *73* is, it won't be dull. Better get a refill on your Diazide so you won't be after me for giving you apoplexy when you read my editorials.



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Wayne Green W2NSD/1
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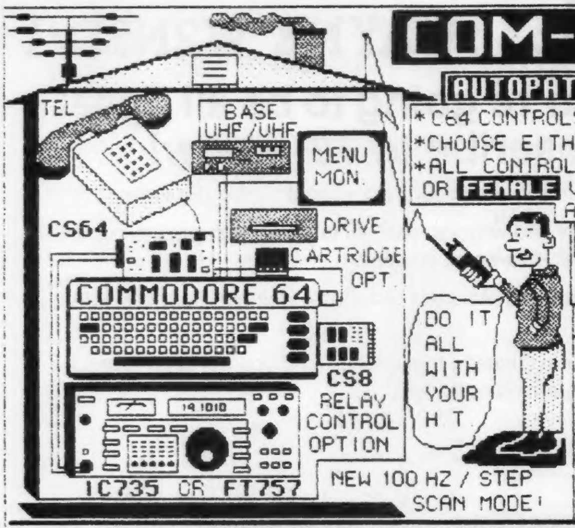

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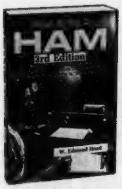
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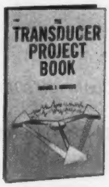
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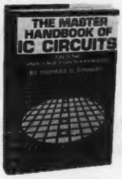
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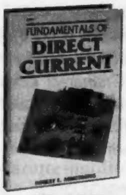
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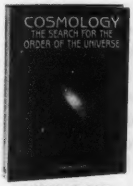
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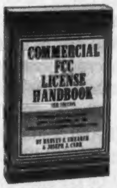
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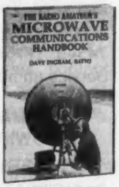
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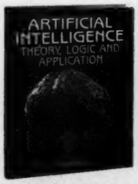
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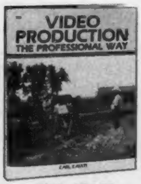
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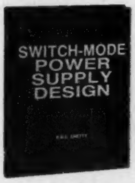
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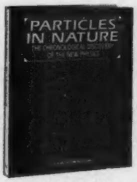
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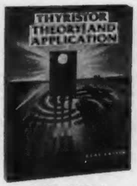
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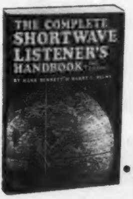
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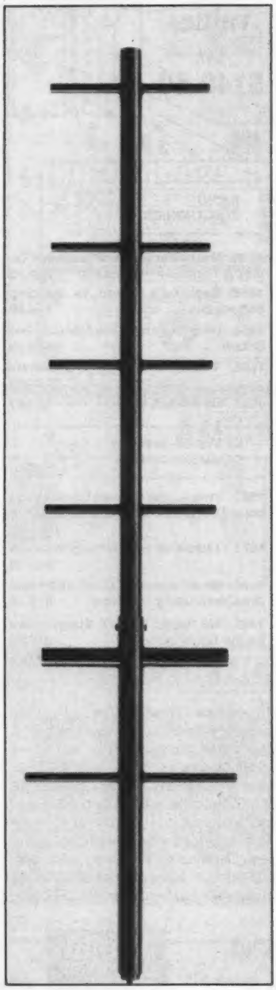


Larsen's new 900-MHz yagi.

LARSEN YAGIS

Larsen Electronics has announced the YA5 series of yagi antennas for use in the 806–860-MHz range. The YA5-806 is designed for cellular-radio operation, while the YA5-900 can be used on the amateur 900-MHz band.

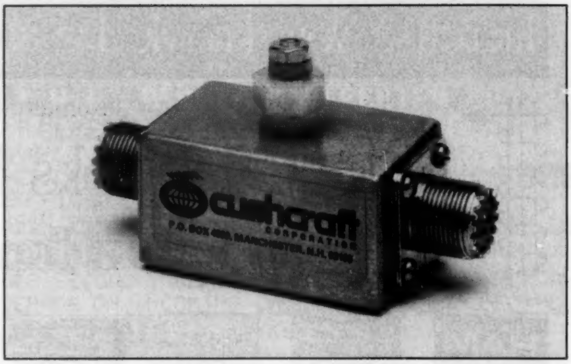
The antennas feature all-weather construction: The coax is terminated inside the yagi, and a black weather-resistant coating is applied at the factory. The antennas have a 10-dBd gain, a horizontal beamwidth of 45 degrees, and can handle up to 300 Watts.

For more information, please contact *Larsen Electronics, PO Box 1799, Vancouver WA 98668; (206)-573-2722.* Reader Service number 153.

NEL-TECH DIGITAL VOICE KEYER

Nel-Tech Labs' DVK-100 is a microprocessor-controlled digital voice storage and announcement system. The DVK-100 is configured with 32 seconds of voice memory divided into four messages of 16, 8, 4, and 4 seconds. Other features include a built-in selectable audio compressor, an end-of-transmission tone, and an amplified local monitor.

The DVK-100 is compatible with all transceivers. Transmitter keying is switch-selectable between positive and negative keying voltage.



Cushcraft's new lightning arrestor.

For complete details, write or call *Nel-Tech Labs, Inc., 28 Devonshire Lane, Londonderry NH 03053; (603)-434-8234.* Reader Service number 155.

C. ITOH COLOR DMP

C. Itoh Digital Products has introduced a seven-color version of their high-speed 80-column ProWriter C-310 and wide-carriage C-315 dot-matrix printers. The DMPs can turn out color graphics with a density of 240 x 216 dots per inch and support popular software packages such as Lotus 1-2-3, Symphony, GEM, and PC-Paint. Print speeds are 300 cps in draft mode, 50 cps in correspondence mode, and 33 cps in letter-quality mode.

The C-310 ($739) and C-315 ($909) come with a variety of resident character fonts and both an 8-bit parallel and an RS-232 serial interface.

For complete information, contact *C. Itoh Digital Products, Inc., 19750 South Vermont Ave., Suite 220, Torrance CA 90502.* Reader Service number 162.

CUSHCRAFT ARRESTORS

Four new coaxial lightning arrestors are available from Cushcraft Corporation. The models offer a choice of power (200 or 2,000 Watts) and connector style (UHF or type N). Replacement cartridges are available.

For more information on these and other Cushcraft products, please contact *Cushcraft Corporation, PO Box 4680, Manchester NH 03108; (603)-627-7877.* Reader Service number 158.

J.S. TECHNOLOGY SINADAPTOR

J.S. Technology's model SAI-01 Sinadaptor is a pocket-sized unit which turns any VOM into a Sinad meter. The only constraints are that the VOM or VTVM must have a sensitivity of 2.5 V ac or better, and that the meter must have a scale marked in dBs.

For complete information, contact *J.S. Technology, Inc., 39 Main Street, Scottsville NY 14546; (716)-889-3048.* Reader Service number 156.

GaAsFET ATV DOWNCONVERTER

P.C. Electronics has added a GaAsFET ATV downconverter for

The DVK-100 digital voice storage and announcement system.

ATV DOWNCONVERTER
6
ON
P.C. ELECTRONICS

900-MHz ATV downconverter available from P.C. Electronics.

the new 900-MHz band to their line of amateur television products. A dual-gate GaAsFET is used in both the rf preamp and the mixer stage for low noise and wide dynamic range. Total conversion gain is about 25 dB.

Two models are available. The TVC-9G ($109) comes installed in a cabinet and is ready to plug into an antenna and a television set. The TVC-9 ($69) is for those who want to package their own system (such as a mast mount).

For more information on ATV products, please contact *P.C. Electronics, 2522 Paxson Lane, Arcadia CA 91006; (818)-447-4565.* Reader Service number 160.

ICOM IC-A2 ACCESSORIES

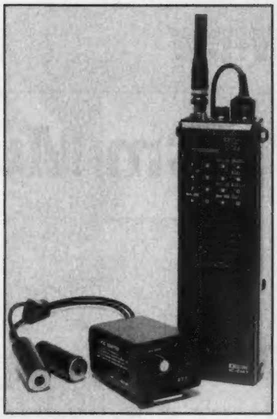
Three new accessories are available for ICOM's IC-A2 handheld airband transceiver.

The IC-CM28 NiCd battery charger ($19.95) operates from any 28-V-dc power source for use in flight or on the ground. (A 12-V cigarette-lighter cord, the IC-CM1, is available for $14.50.)

An alkaline battery case, the IC-CM12 ($24.95), holds ten AA cells for an output of 5 Watts from the IC-A2.

Hands-free VOX operation is possible with the addition of the David Clark Company DC VOX unit ($199.95). The VOX interface is designed to plug directly into a DCCI aviation headset, and can be adapted for use with nearly any standard headset.

For more information on the IC-A2 and its accessories, contact *ICOM America, Inc., PO Box C-90029, Bellevue WA 98009-9029.*



Accessories for ICOM's IC-A2 airband hand-held.

PALOMAR TUNER TUNER

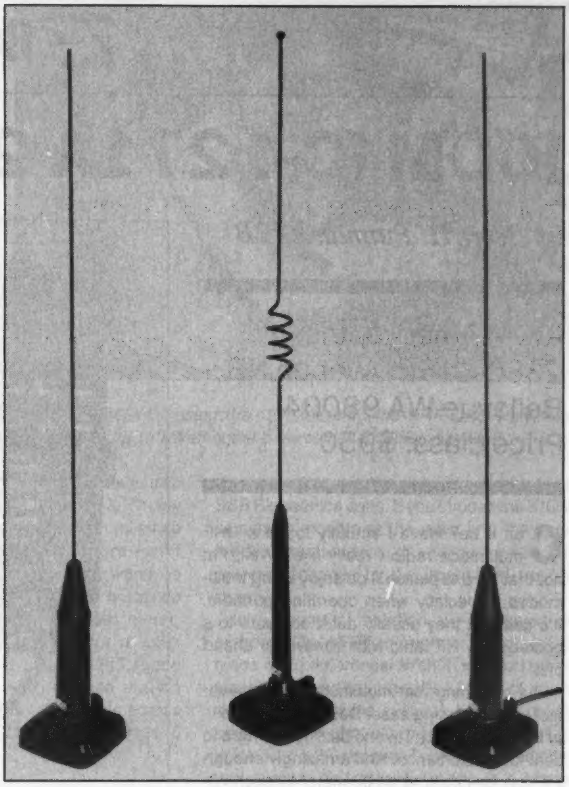
Palomar Engineers has announced the Tuner Tuner™, a device which connects between the transceiver and antenna. A built-in 50-Ohm noise bridge gives an audible null in the receiver when the antenna-matching unit is adjusted properly, eliminating the need to transmit into a high vswr while tweaking the antenna tuner.

The Tuner Tuner (model PT-340) retails for $99.55 plus $4 shipping and handling—for more information, contact *Palomar Engineers, Box 455, Escondido CA 92025; (619)-747-3343.* Reader Service number 157.

YAESU AD-2 DUPLEXER

Yaesu has announced the new AD-2 Duplexer for the FT-2700RH and FT-726R transceivers. The AD-2 provides for semi- or full-duplex crossband operation with a single 2m/70-cm antenna. Band-to-band isolation is 50 dB; insertion loss is less than 0.3 dB at VHF and less than 0.5 dB at UHF. The AD-2 can handle 50 Watts of rf.

For further details, please write *Yaesu Electronics Corporation, PO Box 49, Paramount CA 90723.* Reader Service number 161.

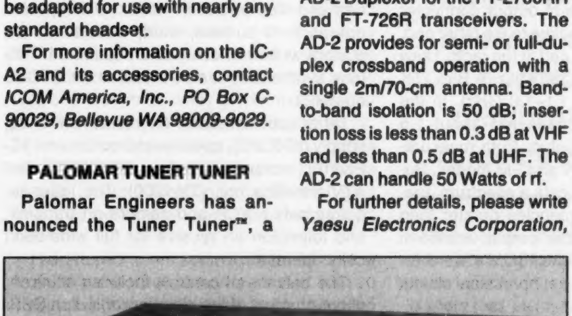


Black Stallion CB antennas from The Antenna Specialists.

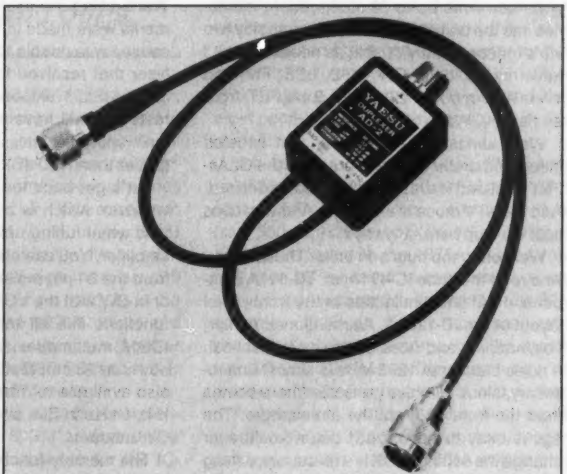
BLACK STALLION CB WHIPS

The Antenna Specialists Company has come up with a new line of mobile CB antennas. Three configurations provide for just about any mounting requirement, including trunk-lip, trunk-mount, and mag-mount. The model M-900 is designed to look like an elevated-feed cellular antenna. All three versions are coated in black Teflon™.

For more details, write *The Antenna Specialists Company, Marketing Dept., PO Box 12370, Cleveland OH 44112-0370.* Reader Service number 159.



Palomar Engineering's Tuner Tuner.



FT-2700RH/FT-726R duplexer allows use of single VHF/UHF antenna.

73 Review

ICOM IC-1271A 23-Cm Multimode

by Peter H. Putman KT2B

ICOM America, Inc.
2380-116th Avenue NE
Bellevue WA 98004
Price class: $950

Photo A. The ICOM IC-1271A 23-cm multimode transceiver.

Can it be? Have I actually found a UHF multimode radio I really like? Well, I'm not that hard to please. I do enjoy using multimodes, especially when operating portable. It's just that they usually don't compare to a good quality HF radio with transverter ahead of it.

But one thing that multimodes have never lacked is operating ease. Despite their receiver limitations, it's all in one box! That's hard to beat for convenience. And amazingly enough we may be closer to an 80-meter-through-70-cm multimode than we think! The Japanese are moving at such a rapid rate in this area that it was only logical that we'd see a multimode for 23 centimeters before long.

Features

ICOM is the first to break this ground with their IC-1271A transceiver. Designed as a companion to their low-band equipment and IC-271/471 series, it covers 1240–1300 MHz. For example, this is the first unit I've used on 23 cm with VOX, adjustable agc, and a noise blanker (somewhat useless and a real oddity!). I can write up to 32 independent memories into the unit and scan them, or employ two vfo's independently or split as needed. And, I have my choice of CW, USB, LSB, FM, and even ATV modes, all with a GaAsFET front end and 10 Watts of rf output!

Well, almost. The particular unit I tested measured under 10 Watts out. And the GaAsFET front end leaves something to be desired. And the ATV mode is an option. And who uses split vfo's up here, anyway?

Well, on to the nuts and bolts: Those of you who read the June IC-471A vs. TS-811A comparison will find similarities in the front-panel layout of the IC-1271A. As mentioned earlier, VOX, AGC, NB, and MODE controls are identical. A noise blanker at 1296 MHz is almost unnecessary, since all noise generated here comes from the front end, not the atmosphere. The agc is okay to have, but I doubt you'll ever change the setting. VOX is a real strange thing to use up here but fun to play with. You will need it to operate CW, however.

As in all ICOM models, the output power is continously adjustable, a nice feature I wish other manufacturers would adopt. On this particular unit, I connected a Bird Thruline section directly to the type-N output connector and a Bird 25-Watt Termaline to the other end. With 14.0 volts dc measured at the radio, I saw 8 Watts of rf output at 1290 MHz. A Bird 25K slug was used (25 W, 1.1–1.8 GHz). In the low-power position, I measured about 1.5 Watts using the same setup. Both measurements were made in CW and FM modes. Because I was unable to locate a spectrum analyzer that resolved frequencies greater than 1200 MHz, I skipped the output waveform tests and will have to take ICOM's word for their spurious emission suppression claims (better than −50 dB).

Let's get back to the controls. A separate TRANSMIT switch is available, which is a real plus when tuning up the typical 23-cm cavity amplifier. You can also enable the transmitter from the 24-pin molex jack on the rear panel, or in CW with the VOX on. The RF GAIN control functions like all other RF GAIN controls on ICOM multimodes, but you'll never turn it down on 23 cm! Multi-speed tuning rates are also available for the vfo knob, which are 25 kHz/1 kHz in FM, and 1 kHz/100 Hz in SSB/CW mode.

The memory functions are useful. You can memorize the frequency as well as the mode. Then, you can employ the MODE-S switch to scan through only those memories that contain your selected operating mode. Dual vfo's are available, and you can lock the front-panel vfo frequency while dialing through the memories and vice versa. In addition, if repeater operation is contemplated, offsets can be custom written. If desired, an optional UT-15 tone synthesizer can be installed for CTCSS operation.

Other options include an internal switching supply (IC-PS25), speech synthesizer unit (IC-EX310), computer interface (IC-EX309), and ATV interface unit (TV-1200). The latter requires only a VCR and camera on transmit, and television on receive for full wide-band color operation.

The balance of controls includes SQUELCH, although most of the signals worked on SSB/CW are so weak they won't break it, and METER, which switches between an FM discriminator mode and conventional S-meter mode as required. CW DELAY, VOX, and CW MONITOR controls are accessible through the top cover as in other ICOM models. A separate external speaker jack is available on the rear panel if needed. Other rear-panel connections include EXT SPEAKER, INTERFACE (for the EX309), DC POWER, ANTENNA, the same 24-pin molex ACCESSORY jack as on other ICOMs, and finally the TV IF INPUT and TV IF OUTPUT jacks for the TV-1200 accessory. As usual, ICOM includes a very detailed, well-written owner's manual and schematic with the unit.

I assume ICOM put these options into this

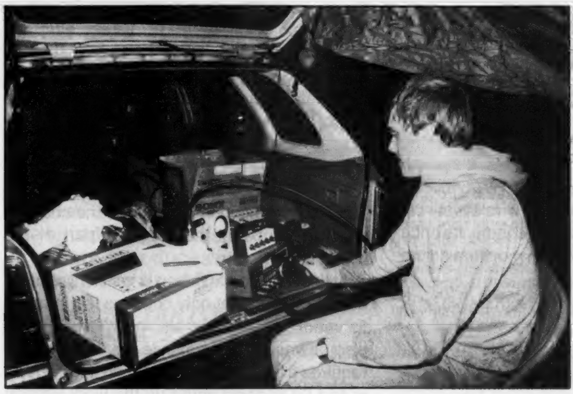


Photo B. KT2B putting the 1271A through its paces in the 1296 Sprint last May. Neither rain, nor snow. . . .

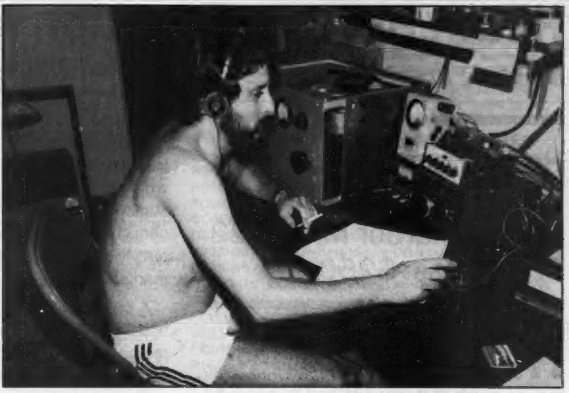


Photo C. WB2WIK using the 1271A during the VHF QSO Party last June. Note the 150-Watt home-brew cavity amplifier to the left.

radio because amateurs in Japan are already busy using these modes. On the other hand, the bulk of 23-cm activity in the United States right now is weak-signal SSB or CW, with a limited amount of FM, ATV, and satellite operation. The vast majority of U.S. owners may never use most of these controls. This could change if Novices gain 1240-MHz privileges, except that the radio runs 5 more Watts than Novices would be allowed to use. Perhaps ICOM will make a modified version of this radio if that happens.

On the Air

It seems that whenever there's a severe drought, all I have to do is decide to operate 432 or 1296 portable from a mountaintop and it rains cats and dogs (Photo B). WB2WIK and I ran the 1296 Sprint from atop Sunrise Mountain in northwestern New Jersey (grid square FN21). We were caught in a large moisture cloud shortly after setting up. The effect of operating into dense clouds at this frequency is well known. Using the unit barefoot, we worked ten stations in four grids, one of which was over 100 miles away in Atlantic City. Our antenna was the F9FT 55-element yagi on 30′ of mast from about 1600′ elevation. With a 13.8-volt battery we measured only 8 Watts output. In this operation, with the high-gain antenna, the receiver gave a good accounting of itself.

I had hoped to run some tests on 23-cm FM from the car, but the companion IC-120 shipped with the review unit had a defective front end and had to be returned to the factory, so my evaluation of the FM performance on the air was limited to using a transverter in the FM mode with my TS-430S. The quality of received audio was good, with crisp response as evaluated on the workbench. Again, the displayed frequency didn't agree with what I measured and was off by about +3 kHz. Signal strength for 20 dB of quieting was in excess of ICOM's claimed spec of 0.32 uV and closer to a microvolt.

Our luck was better during the June VHF QSO Party. Received reports indicated clean audio on SSB and no detectable chirp on CW. The PLL system is stable but not very accurate. When the display indicated we were operating on 1296.090 MHz, the measured frequency was actually 1296.093. In my opinion, this is acceptable at 23 cm since virtually all equipment in use here is off frequency by a few kHz as well. It won't be a problem on FM, as you'll see the presence of a carrier on the signal-strength meter. But you might go nuts looking for a weak SSB signal unless you use the RIT (good for plus or minus 2.5 kHz) or tune the vfo around a bit. Rf output is fairly stable across the range of 1240–1300 MHz, falling to 6 Watts at 1240 MHz.

> ***"It seems that whenever there's a severe drought, all I have to do is decide to operate 432 or 1296 portable from a mountaintop and it rains cats and dogs."***

The receiver utilizes a MGF1202 GaAsFET, and ICOM claims sensitivity in the SSB mode to be less than 0.16 uV for 10 dB S+N/N. I'll dispute that, as my SSB Electronics transverter is rated about the same but really does meet the specification. The ICOM appears to be more in the range of .7–.85 uV for 10 dB S+N/N. In fact, it took a really strong local signal which was line-of-sight running 100 Watts to make the S-meter pin hard. As in the case of the IC-471A, the 1271A meets and exceeds its claimed selectivity specs of better than 2.4 kHz at −6 dB in SSB/CW and better than 15 kHz at −6 dB in FM mode.

The radio really needs a preamp for serious weak-signal work. ICOM advises that a mast-mount preamp is available for the IC-1271A, although there isn't much mention of it in the owner's manual. My suggestion would be to employ either an internally mounted unit or a good rf/dc switched preamp, such as the SSB Electronics units. If you choose the ICOM version, it mounts at the mast and the coax feedline multiplexes rf and dc to run the preamp, actuated by the front-panel PREAMP switch.

In our contest operation, we employed an outboard GaAsFET to improve sensitivity. It made a big difference! With it, we worked 18 stations in 9 grid squares, the furthest of which was over 200 miles away. A 3CX100 cavity amplifier was also used, running about 130 Watts to 4 x 23-element Tonna yagis. Having the memory and scan functions is a bonus during contests, since you never can be sure where someone will pop up on the band during a schedule. Some stations who tried to work us were as far as 6 to 10 kHz off the agreed upon frequency!

Conclusion

If you like to run multimodes, the IC-1271A will be a nice addition to your shack for 23-cm operation provided you: (1) use a good-quality external GaAsFET preamplifier, (2) employ low-loss feedline and a high-gain antenna, and (3) have about $900 to spend. Whoa! $900? Yep, every penny of it. This is not a cheap radio by any means, and there's no doubt you can buy a good transverter for half that which will run rings around the IC-1271A. That's also a lot of money for a band that most people use only six times a year during contests.

The key here is activity. Should Novices gain 23-cm privileges and should the price of this unit drop to a more reasonable level (say, 500–600 dollars), ICOM will be sitting in the catbird seat with the 1271A, and it might just open up the band to more users, especially those interested in fast-scan color ATV operation. Although 23-cm repeaters aren't practical for wide coverage in hilly areas, I could see Novices using community repeaters with these units for FM and packet, with occasional forays into the weak-signal modes. But it's great for mountaintop and portable operation, as the 1271A weighs only 14 pounds.

And to think a transceiver like this was just a pipe dream five years ago. ■

Heath HO-5404 Station Monitor

by Marc Stern N1BLH

Heath Company
Dept. 011-442
Benton Harbor MI 49022
Price class: $250

How many times have you heard a signal on 20 meters that's so broad and splatters so much that you just had to see it for yourself and, maybe, tell the other operator about it? With the congestion on HF today, the chances are pretty good that you've run into this situation at least once an operating session.

The next question that will probably arise, if you're serious about it, is: "How do I go about it?" If you can afford it, you might consider tying up a lab-grade oscilloscope at a slow sweep speed and a lower frequency response level. But there are few operators who can afford this luxury, especially if the scope is used for other things. The solution, then, is a station monitor, which also can double as a minimal level oscilloscope.

Usually inexpensive enough to be dedicated to monitoring station activity alone—$250—most station monitors add to their utility by offering pan-adapter modules so they will also function somewhat as spectrum analyzers.

Further, station monitor scopes are made to handle station monitoring chores, unlike oscilloscopes whose primary missions are for far more sophisticated chores. For example, the average station monitor scope comes equipped with audio level inputs, while you must use clip leads and, possibly, attenuator pads—if the audio drive is too high—so an oscilloscope can handle station monitoring.

And this brings us to the topic at hand, the Heathkit HO-5404 Station Monitor. It's a unit which is made to be part of an HW-5400 HF station, so it follows Heathkit's relatively recent change to a brown color scheme. Its price puts it in line with other station monitors on the market.

A competent unit, the HO-5404 arrives in two boxes. The first contains the chassis, motherboard, demodulator board, and their associated parts; the second contains the cathode ray tube.

As you first look at it, two things strike you: (1) You wonder why Heath used such a big box for so few components—the chassis is 11-1/4" x 12-1/8" x 1-3/8" and it weighs 10.6 pounds—and (2) you notice that it's an organized kit.

Rather than engaging in its former practice of providing bags and boxes of parts which were arranged in a seemingly helter-skelter manner, Heath has organized everything neatly and logically. Major subassemblies and their parts are grouped together so that everything is easy to find and check.

Once this is finished, the first major assembly is the demodulator board, after which you move on to the motherboard. The demodulator board takes about an hour or so to put together and the motherboard takes another four or five.

If you look carefully as you assemble the kit, you can see there is a subtle pattern in the way the components are mounted. As each wave of mounting washes across the board, you notice the close-mounted items, such as resistors and diodes, are mounted first. Then come the medium-height mounts, such as capacitors. Finally, the transistors are mounted. It does make things more convenient as you stuff the board.

Heathkit
SSB
TRAP
RTTY
100Hz
10kHz
100kHz
POWER
ATTENUATOR
SWEEP
FOCUS
INTENSITY
VERTICAL
HORIZONTAL
GAIN
POSITION
GAIN
POSITION
Station Monitor HO-5404

Heath's HO-5404 Station Monitor.

With these items out of the way, you begin to assemble the chassis, with the rear connectors first. These connectors include antenna inputs as well as vertical and horizontal inputs. The attenuator switch and power line also are installed in this area.

After these connectors are installed, you turn your attention to the front of the chassis, which is probably the toughest part of the assembly.

At the front, the first step is installing a huge plastic decal. It not only contains the labeling for various potentiometers and switches, but it also serves as the graticule for the scope. It requires a great deal of care to do this correctly and I'd suggest lining up the work several times before you peel the covering off the back. The glue on the back holds like iron, and once you've put it on there's no turning back. So, if it's crooked, you're in for an interesting time trying to get it off and reposition it. Fortunately, rather than rush ahead, I took my own advice and lined everything up—and placed it on the first try.

> ***"The real strength of the HO-5404 is that you built it and know it thoroughly. You can go in and troubleshoot a problem and replace a bad part."***

The decal and the installation of the potentiometers and switches are the easiest steps of the process. Because once you've installed the switches—the motherboard is also installed about now—you must begin to wire them up in place. Not only does this call for care, it also calls for a steady hand with the soldering iron because it gets pretty crowded with wires and other pot-mounted components—capacitors, for example—very quickly. It's also a very tedious job that quickly becomes tiring and, as we all know, tiredness leads to inattention.

Once this is done, you must then wire up the switches, an even more tiring job because it seems like there are twice the number of connections to be made.

Quite frankly, this seems to be a time-wasting, backwards method of mounting and wiring switches and pots. I would urge the procedures to be turned around so that everything is wired up outside the chassis and then installed. This would make it easier for the kit builder, who would be worried only about the length of the leads instead of burning through wires in a jungle of tangled connections with already-installed components. It would also lessen the potential for mistakes because it is possible to attach a wire to the wrong point as the jungle of wires grows. The same is true of the switches.

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Frequency range: 25-550 MHz. continuous coverage and 800 MHz. to 1.3 GHz. continuous coverage.

The *Regency* MX7000 scanner lets you monitor Military, Space Satellites, Government, Railroad, Justice Department, State Department, Fish & Game, Immigration, Marine, Police and Fire Departments, Broadcast Studio Transmitter Links, Aeronautical AM band, Aero Navigation, Paramedics, Amateur Radio, plus thousands of other radio frequencies most scanners can't pick up. The *Regency* MX7000 is the perfect scanner to receive the exciting 1.2 GHz. amateur radio band.

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Bands: 30-50, 88-108, 118-136, 144-174, 440-512 MHz.

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Bands: 30-50, 118-136, 144-174, 440-512 MHz.

The *Regency* Z45 is very similar to the Z60 model listed above however it does not have the commercial FM broadcast band. The Z45, now at a special price from Communications Electronics.

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10 Channel • 25 Watt Transceiver • Priority

The *Regency* RH250B is a ten-channel VHF land mobile transceiver designed to cover any frequency between 150 to 162 MHz. Since this radio is synthesized, no expensive crystals are needed to store up to ten frequencies without battery backup. All radios come with CTCSS tone and scanning capabilities. A monitor and night/day switch is also standard. This transceiver even has a priority function. The RH250 makes an ideal radio for any police or fire department volunteer because of its low cost and high performance. A *60 Watt* VHF 150-162 MHz. version called the **RH600B** is available for $454.95. A UHF 15 watt version of this radio called the **RU150B** is also available and covers 450-482 MHz. but the cost is $449.95.

NEW! Bearcat® 50XL-GS

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10-Band, 10 Channel • Handheld scanner

Bands: 29.7-54, 136-174, 406-512 MHz.

The Uniden Bearcat 50XL is an economical, hand-held scanner with 10 channels covering ten frequency bands. It features a keyboard lock switch to prevent accidental entry and more. Also order part # **BP50** which is a rechargeable battery pack for $14.95, a plug-in wall charger, part # **AD100** for $14.95, a carrying case part # **VC001** for $14.95 and also order optional cigarette lighter cable part # **PS001** for $14.95.

NEW! Scanner Frequency Listings

The new Fox scanner frequency directories will help you find all the action your scanner can listen to. These new listings include police, fire, ambulances & rescue squads, local government, private police agencies, hospitals, emergency medical channels, news media, forestry radio service, railroads, weather stations, radio common carriers, AT&T mobile telephone, utility companies, general mobile radio service, marine radio service, taxi cab companies, tow truck companies, trucking companies, business repeaters, business radio (simplex) federal government, funeral directors, veterinarians, buses, aircraft, space satellites, amateur radio, broadcasters and more. Fox frequency listings feature call letter cross reference as well as alphabetical listing by licensee name, police codes and signals. All Fox directories are $14.95 each plus $3.00 shipping. State of Alaska–**RL019-1**; State of Arizona–**RL025-1**; Baltimore, MD/Washington, DC–**RL024-1**; Buffalo, NY/Erie, PA–**RL009-2**; Chicago, IL–**RL014-1**; Cincinnati/Dayton, OH–**RL006-2**; Cleveland, OH–**RL017-1**; Columbus, OH–**RL003-2**; Dallas/Ft. Worth, TX–**RL013-1**; Denver/Colorado Springs, CO–**RL027-1**; Detroit, MI/Windsor, ON–**RL008-3**; Fort Wayne, IN/Lima, OH–**RL001-1**; Hawaii/Guam–**RL015-1**; Houston, TX–**RL023-1**; Indianapolis, IN–**RL022-1**; Kansas City, MO/KS–**RL011-2**; Long Island, NY–**RL026-1**; Los Angeles, CA–**RL016-1**; Louisville/Lexington, KY–**RL007-1**; Milwaukee, WI/Waukegan, IL–**RL021-1**; Minneapolis/St. Paul, MN–**RL010-2**; Nevada/E. Central CA–**RL028-1**; Oklahoma City/Lawton, OK–**RL005-2**; Orlando/Daytona Beach, FL–**RL012-1**; Pittsburgh, PA/Wheeling, WV–**RL029-1**; Rochester/Syracuse, NY–**RL020-1**; San Diego, CA–**RL018-1**; Tampa/St. Petersburg, FL–**RL004-2**; Toledo, OH–**RL002-3**. New editions are being added monthly. For an area not shown above call Fox at 800-543-7892. In Ohio call 800-621-2513.

NEW! Regency® HX1500-GS

List price $369.95/**CE price $239.95**

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With all of this done, the final step is installing and wiring up the CRT and connector. This, again, is straightforward, although it does pay to take care not to handle the CRT too roughly to limit chances of breaking it.

At this point, you're ready for the tuneup which also is straightforward and simply involves balancing the vertical and horizontal amplifier sections. This involves setting a couple of pots on the motherboard so that the circuits are balanced at 80 volts. It was at this point that I began to go somewhat gray as I kept on trying to get the vertical circuitry balanced and it wouldn't. Each time, one side would be at 80 and the other would be at 137, and when I adjusted the other side, the first would be out of adjustment.

Checking things out, it looked as if one of the driver transistors in the amplifier section was bad—Q104 and Q106—and I called customer assistance.

As I explained what was going on to the customer assistance rep, he quickly diagnosed the problem—Q104—and transferred me to the parts department where he had already ordered the new part to replace the offender on the motherboard. All I had to do was give my name and address. Less than a week later, the part arrived; I installed it, and everything was aligned quickly.

The acid test came when I put it on a rig and fired it into the dummy load. After adjusting everything according to instructions, I keyed the microphone and everything appeared as the documentation said it would.

I then went on to monitor my radioteletype signals, packet signals (just to see what they looked like), CW signals, and phone signals. As I watched the phone signals, one thing became clear to me: Too many operators have their speech compressors cranked up way too high and their signals are splattering all over the place. Nearly every signal I looked at on 75 was flat-topped and splattered everywhere.

The strength of the Heathkit HO-5404 Monitor Scope isn't so much that it will serve as a good station monitor for VHF (1.8 to 54 MHz) or even as a reasonable 5-MHz scope (10–40-kHz vertical response and 10–300-Hz horizontal response) for bench purposes. It's a strong performer in both roles and is easy to use since there are only seven switches and eight pots in front, some of which you set once and forget.

The real strength of the HO-5404 is that you built it and know it thoroughly. You can go in and troubleshoot a problem and replace a bad part. This is possible because the scope uses discrete components rather than Very Large Scale Integration techniques. It is probably one of the few kits on the market that isn't stuffed full of ICs that you can't work on.

Another real strength is its documentation. Not only does it lead you step-by-step through the scope's construction and alignment, but it also guides you through troubleshooting procedures and gives suggestions should a problem arise. It also has a theory-of-operation section that explains precisely how the scope works, which is a refreshing change in this day of appliance manuals.

Further, the manual gives you valuable examples of the types of scope patterns you will see given a certain set of conditions (chirping, splattering, flat-topping, for example).

Despite these strengths, there is a sobering thought that occurs to me and that is cost. Operators used to build kits because they were less-expensive alternatives to over-the-counter gear. But with Heathkits costing nearly the same as fully assembled gear, it makes you wonder why an operator would build instead of buy.

In my case, I feel a sense of satisfaction, but I can't say that I've learned anything from it, other than how to stuff a board. I also am familiar with the innards of the gear and it is fairly easy to work on. But I can't say that this is the situation with the rest of the amateur world. Surely, there are many who agree with me, but there are many more who would prefer to plunk down their plastic and buy ready-made gear.

And who's to say who's right? The only piece of advice I have for Heath is to consider realigning the pricing structure of their gear. If they can afford to cut margins and make their equipment the low-cost alternative again, they'll stand a chance of revitalizing a whole marketplace. Heath's equipment is good and something you can get your hands on. Now, isn't that something in this day of tiny rigs and tinier parts? You bet it is! Reader Service number 151.■

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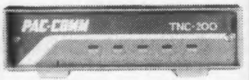

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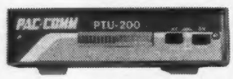

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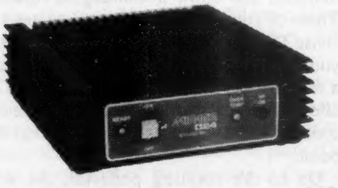

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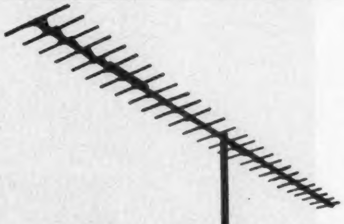

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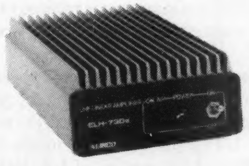

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A Rotatable *What?*

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This project started about two years ago while I was in the midst of erecting a Tri-Ex DX-86 tower in Spring Valley, New York. No doubt about it, the DX-86 is a lot of tower, standing 86 feet tall when fully raised and capable of supporting 25 square feet of wind loading. At 2100 pounds, it's probably the biggest crank-up available to amateurs.

I had previously owned a Tri-Ex LM-470, but was intrigued with the thought of 16 extra feet and additional capacity, since plans had been in the back of my head to put up arrays for 40 meters through 23 cm and build a super contest station. Unfortunately, the number of yagis I had in mind would exceed the wind load capacity of even the best rotors available.

Sure, a custom-built rotor would have fixed this problem, but as a welder I have certain skills and resources not available to most amateurs. Why not use a fixed mast to support the huge yagi arrays and rotate *the entire tower?* Why not, indeed! And so began one of the stranger but more rewarding projects I've ever been involved with.

The DX-86 was ordered from Tri-Ex and I set about creating the specifications. First, I'd need a strong mast—*very* strong. Not only that, since it couldn't rotate down or be dropped (being securely fastened in one position), some method of climbing the mast easily to do antenna work was needed.

The solution was to employ two separate pieces of pipe, the first a 21' x 2" piece of extra-heavy-wall seamless steel, the second a 28' x 1-1/2" piece which slid inside the first piece. Next, I cut sections of 5/8" Rebar and drilled the combination mast every 20", sliding the Rebar sections through to pin the two masts together and form a ladder to climb up. Neat!

Next, the top of the DX-86 was modified by replacing the mast guide with 2-1/2" pipe fitted with a steel plate so as to form a key at the lower end. This was bolted to the tower in place of the old mast guide. The combination mast section had a key slot machined into its lower end to fit into the steel plate, resulting in an extremely strong support. The 256-lb., 28-foot mast could now support two climbers to allow antenna work in any tower position, up or down. I could remove the mast if needed by lifting it out with a ginpole or small crane.

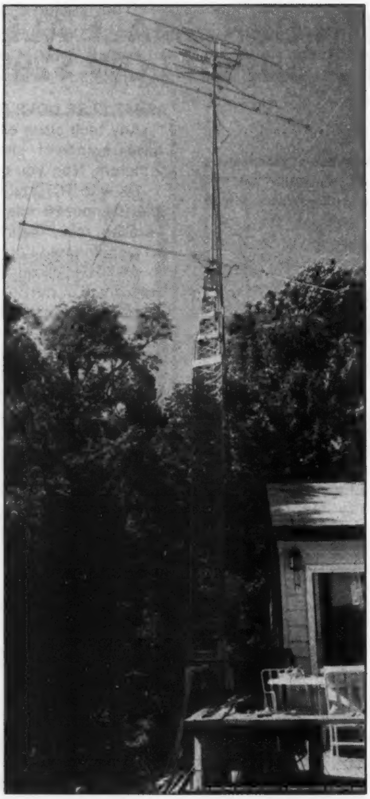

Photo A. The completed tower with about half of the antennas installed. Even in the cranked-down position it is over 60 feet tall. (Photo by KT2B.)

The DX-86 employs five sections, with extra-heavy cross bracing, thick walls on the extension sections, and roller guides to cut down on friction during crank-up or crank-down. However, I did replace the stock 1-HP, 220-volt crank motor with a remote-controlled 24-volt system so as to allow crank-up and crank-down operations from inside the house. This system was designed by Paul Olsen and features on/off lamp indicators for the "end of crank" limit points, as well as limit switches on the tower itself. These were very important, as I wouldn't be able to see the tower from my shack during operation.

While I was tackling the cranking problem, I decided to employ a custom-designed rotor-indicator system. (Remember now, I was rotating the entire DX-86 on a pedestal!) An old friend, Bob Nyire WA2AJV, came up with the solution, employing selsyn motors and indicators which were modified for the application by Phil Anderson W2HWG. These motors are connected to the rotor gear mechanism (I'll get to that in a moment) and allow a 400-degree rotation. Those of you who have operated contests or chase DX will remember the times you had your rotor on the east side of south and heard a rare one just the other side of south! This allows the extra rotation needed to make that contact. Limit switches kick in beyond this point.

On to the rotating pedestal. As with most big tower projects, you've got to start with a hole in the ground. The spot I chose for the DX-86 allowed no room for digging equipment, so I did it the good old-fashioned way—by hand. After getting about 2-1/2 feet deep rather quickly, I hit hardpan, the next best thing to solid rock. Talk about tedious work! I measured progress in inches each day after work, but after many backrubs and jars of liniment, the hole was 6-1/2 feet deep by about 4-1/2 feet on a side, and it was time to pour the concrete base.

Allowing for a 6" form above the ground, it would take about 7 yards of concrete to do the job. Before this could be done, a steel anchorage for the pedestal base needed to be installed. This was made from 450 pounds of #7 and #8 Rebar welded into a cage form four feet on a side and six feet high. Additionally, I welded eight 8-inch pieces of 1-inch threaded rod to the top of the cage, which would protrude through the concrete and form the anchor points for the pedestal.

The pedestal carries the full weight of the DX-86 and supports the drive gear and turntable as well. For this application, I selected steel angle stock in 4'x 6'x 1/2" and 4'x 4'x 1/2" lengths. The shape is much like a pyramid with the top chopped off, tapering upward. The bottom is four feet square and sits nicely on the eight anchor bolts.

Total pedestal height is 6 feet. The retracted tower on the pedestal measures over 60 feet to the top of the mast! Fitted to the top of the pedestal is a 3-foot-diameter plate of 1-inch-thick steel. This plate has been machined with eight 3" slots that hold roller bearings, which in turn support a 1-3/8"-thick plate that forms the base of the tower.

> **"The rotor can rotate virtually any tower—even a good, straight utility pole if need be."**

Here's where it gets tricky: Since this plate and the bearings form a "lazy-susan" arrangement, I had to grind, re-grind, and re-re-grind the plate to make sure it was absolutely flat. Nothing would look more unappealing than an 86-foot tower wobbling around in circles. Sure wouldn't help the neighbors' confidence level, either, especially those within 90 feet of the tower!

To complete the picture, I had to construct a means of turning the lazy-susan arrangement and provide additional support for this mass of metal balanced on a 3-foot plate. This was accomplished by selecting a piece of 6"-diameter, 1/2" wall steel tubing and welding a 6" heavy-duty pipe flange to one end. This was then turned in a lathe to make the flange absolutely square to the pipe. This shaft passes through both the upper rotating plate (which it's bolted to) and the lower bearing-support plate, via a 6"-diameter roller bearing.

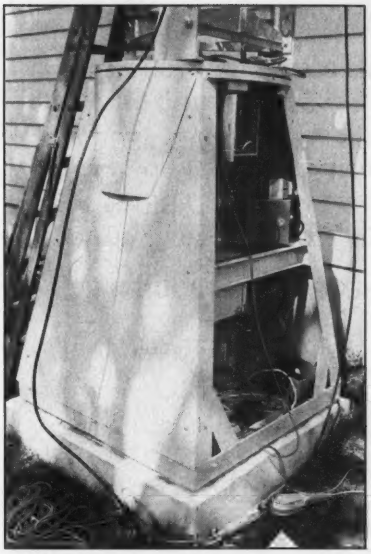

Photo B. The base pedestal with the cover removed. The large concrete base is visible, as is the lazy-susan turntable at the top. (Photo by KT2B.)

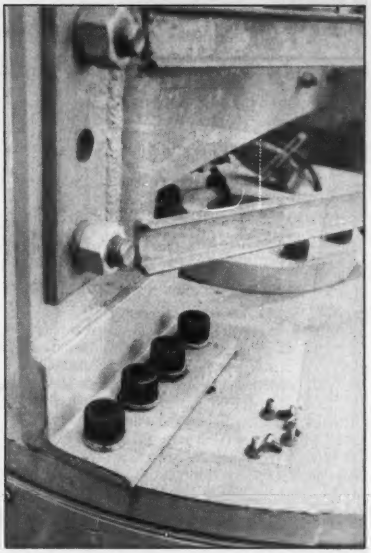

Photo C. Close-up of the method used to attach the tower to the rotating plate. (Photo by KT2B.)

The lower end of the shaft is also supported by a roller bearing to restrict side wobble and ensure proper centering. In addition, this end has a 22"-diameter, 1/2" #50 roller chain sprocket attached to it, forming the drive mechanism. A smaller roller chain sprocket on the shaft drives the selsyn position indicators and activates the limit switches when necessary.

To actually turn the beast, I selected a Dayton 1/2-HP, 120-V-ac motor rated at 1725 rpm output. Fastened to the drive gear is a double-reduction Ohio Gear Manufacturing right-angle worm drive, resulting in an 11-rpm shaft speed. Next, I fitted a 2-1/4", #50 roller chain sprocket to the output of the worm drive—and this is what drives the 22" sprocket on the rotor shaft. The final output torque from the motor/drive combination is about 20,000 lb!

The DX-86 will rotate a full 400 degrees in about 62 seconds, and do it with about as much noise as a small TV antenna rotator—it's that quiet. Best of all, there are no solenoid brakes to seize up or worry about (a common problem with Ham-4 or TailTwister rotors). The final touch was to paint the

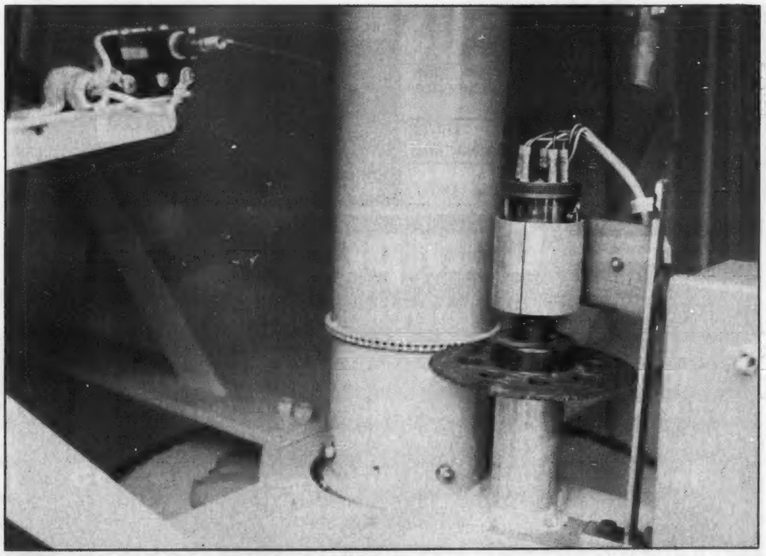

Photo D. The reduction gear mechanism for driving the selsyn direction indicator. A limit switch is visible at upper left. (Photo by KT2B.)

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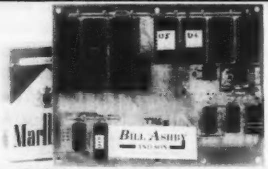

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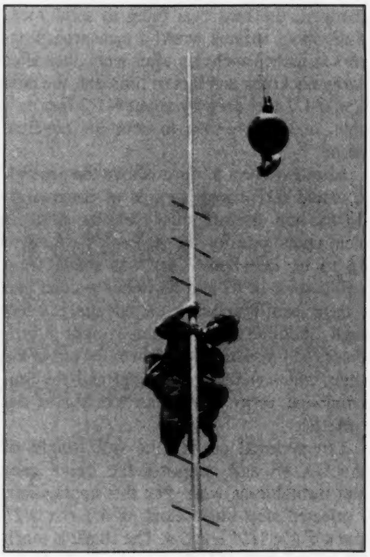


Photo E. The mast has just been installed with the help of a crane. WA2VUN is standing on Rebar steps. (Photo by WB2WIK.)

pedestal the same color as my house siding, so it blends in better.

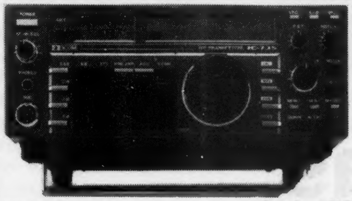
Current plans are to install the following antennas (some, if not all, will be up by the time you read this):

4-element, 144-MHz yagi (FM)
7-element, 220-MHz yagi (FM)
Four 23-element, 1296-MHz arrays
Two 19-element, 432-MHz arrays
Two 17-element, 220-MHz boomers
Two 19-element, 144-MHz boomers
Two 7-element, long-boom 50-MHz yagis
Hy-Gain 205 BAS for 20 meters
Hy-Gain 105 BAS for 10 meters
Telrex TB-5 Tribander
KLM 3-element, 40-meter beam

The design, construction, and installation of this rotating tower took about one year (dovetailed into my work and play schedule) working days, weekends, and even nights where needed. As mentioned earlier, my main business is welding and fabrication. Note that all materials used are strictly "off the shelf" with the exception of the rotor, which can rotate virtually any tower—even a good, straight utility pole if need be.

If readers would like further details regarding construction and operation, I'd be glad to provide details upon request. (Please send an SASE.)

I'd like to thank the following people for making it all possible: my two kids, Jennifer and Matthew, for helping dig the hole; Bob Nyire WA2AJV for all his thoughts and input regarding the rotor and controls; Paul Olsen for the lift electronics design; Phil Anderson W2HWG for his help on the selsyn indicators; and finally, my wife, Jo-Ann, for putting up with all of the long hours I spent at my shop. ■



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FL-32 500 Hz CW filter	66.50	
EX-243 Electronic keyer unit	56.00	
UT-30 Tone encoder	17.50	

	Regular	SALE
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PS-35 Internal power supply	199.00	**179^{95}**
EX-241 Marker unit	22.50	
EX-242 FM unit	44.00	
EX-243 Electronic keyer unit	56.00	
FL-45 500 Hz CW filter (1st IF)	66.50	
FL-54 270 Hz CW filter (1st IF)	53.00	
FL-52A 500 Hz CW filter (2nd IF)	108.50	**99^{95}**
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PS-35 Internal power supply	199.00	**179^{95}**
FL-32 500 Hz CW filter (1st IF)	66.50	
FL-63 250 Hz CW filter (1st IF)	54.50	
FL-52A 500 Hz CW filter (2nd IF)	108.00	**99^{95}**
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Accessories for Deluxe models	Regular
BP-7 425mah/13.2V Nicad Pak - use BC-35	74.25
BP-8 800mah/8.4V Nicad Pak - use BC-35	74.25
BC-35 Drop in desk charger for all batteries	74.95
BC-16U Wall charger for BP7/BP8	20.25
LC-11 Vinyl case for Dlx using BP-3	20.50
LC-14 Vinyl case for Dlx using BP-7/8	20.50
LC-02AT Leather case for Dlx models w/BP-7/8	54.50

Accessories for both models	Regular
BP-2 425mah/7.2V Nicad Pak - use BC35	47.00
BP-3 Extra Std. 250 mah/8.4V Nicad Pak	37.50
BP-4 Alkaline battery case	15.35
BP-5 425mah/10.8V Nicad Pak - use BC35	58.50
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FL-32 500 Hz CW filter	66.50	
FL-63 250 Hz CW filter (1st IF)	54.50	
FL-44A SSB filter (2nd IF)	178.00	**159^{95}**
EX-257 FM unit	42.50	
EX-310 Voice synthesizer	46.00	
CR-64 High stability oscillator xtal	63.00	
SP-3 External speaker	61.00	
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With eight high-frequency amateur bands (1.8, 3.5, 7, 10, 14, 21, 24, and 28 MHz) and one more band to be added soon (18 MHz), it is not practical to have a separate coax-fed dipole for each band. It would also be difficult to design a trapped antenna that would work on all of these bands. However, by using the kinds of antennas that were common in early days of amateur radio, *one* antenna can be made to provide good results on all of these bands.

If an historian were to write a history of amateur radio antenna design, he would divide this history into two periods. The first period would be the B.C. (before coax) period in which the objective of antenna design was to obtain the best possible performance. The second period would be called the A.C. (after coax) period. The convenience of coax, combined with human laziness, changed the course of amateur antenna design—antennas had to perform with coax feedlines. It has now become apparent that much performance was sacrificed in order to have coax feedlines. This was especially true with respect to multiband antennas. Now, many hams are using B.C.-type antennas.

Such an antenna can be built for very little money. Furthermore, on the higher bands, these antenna systems have *gain* as compared to a half-wavelength dipole. When erected in the form of an inverted vee, these antennas send and receive well in all directions.

The purpose of this article is to describe three nine-band antenna systems, to give approximate values of their gain for each band (as compared to a half-wave dipole for that band), and to present the directional patterns for each band.

All three of these antenna systems are fed with balanced tuned feeders and require a little work in adjusting an antenna tuner (or "transmatch") that has a balanced rf output. This little bit of work provides greatly improved performance as compared to a coax-fed antenna.

Antenna Number One

The first antenna to be discussed is a half-wavelength centerfed zepp for 3.5 MHz (the correct name for this type of antenna is a "tuned doublet," but it is commonly called a centerfed zepp). Each side of the center insulator should be approximately 66 feet long. (The exact length is not important so long as the wires on each side of the center are the same length; 60 feet could be used if that would be more convenient.) The tuned feedline can be made of either open-wire (ladder) line or of good quality twinlead (preferably of the heavy-duty transmitting type). It is often convenient to use open-wire line from the center of the antenna to the grounding switch outside of the shack and to use twinlead from

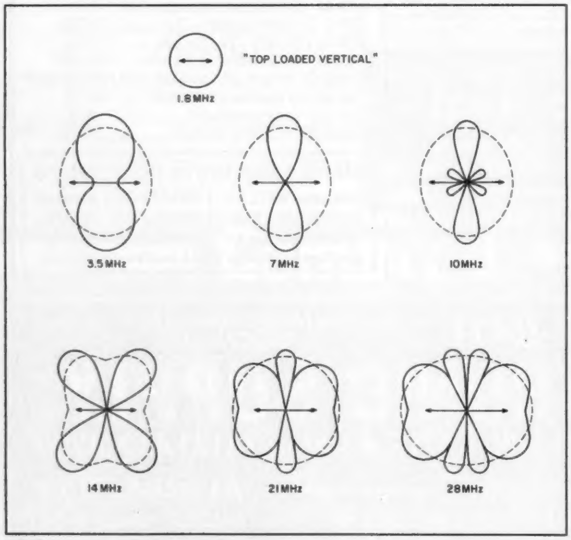

Fig. 1. Approximate directional patterns for antenna number one (66 feet each side of the center). The dotted lines show the patterns when the antenna is in the form of an inverted vee.

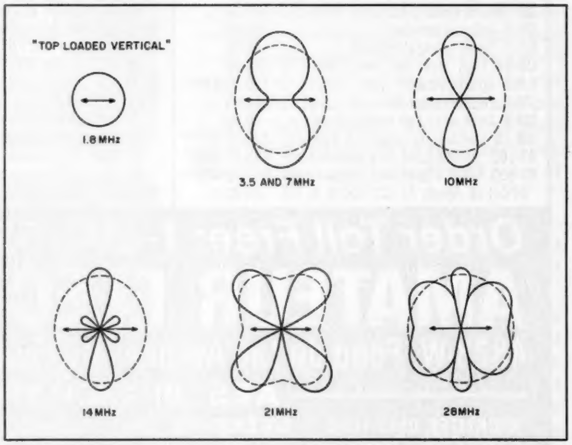

Fig. 2. Approximate directional patterns for antenna number two (51 feet each side of the center). The dotted lines show the patterns when the antenna is in the form of an inverted vee.

the grounding switch to the antenna tuner inside the shack.

Some amateur operators think that tuned feeders (or resonant lines) must be in the form of open-wire or ladder lines. This is not true. Excellent results can be obtained using good quality twinlead. The feedline to my big tuned doublet contains about 50 feet of homemade open-wire line and about 50 feet of three different kinds of twinlead, all in series.

The directional patterns and gains of this antenna (as compared to a dipole for each band) are shown in Fig. 1, and how to use the antenna system on the 1.8-MHz band will be explained later in the article.

On the 3.5-MHz band, the antenna system functions as a half-wavelength dipole. However, it will work much better than a coax-fed dipole because the antenna system can be tuned to resonance at the exact frequency being used, whether the frequency is near the low end of the CW band (3.500 MHz) or near the high end of the phone band (4.000 MHz). The antenna will send and receive best at right angles to the antenna wires. However, if the antenna is in the form of an inverted vee, it will send and receive reasonably well in all directions. For best east and west coverage, the antenna wires should run north and south.

Antenna engineers do not consider the inverted-vee configuration to be a good antenna design. Having the ends of the antenna nearer the ground than the center introduces losses not present when the antenna is horizontal. If the antenna is an inverted vee, it is a good idea to have the angle between the wires at the center of the antenna at least 120 degrees. In spite of the views of antenna engineers, many amateurs use inverted-vee antennas with good results.

On the 7-MHz band, the antenna will function as two half-wave antennas fed in phase. *It does not* function as a full-wave antenna, as was erroneously stated in a past *73* article ("So Why Do They Call It Wireless?" March, 1985). The gain as compared to a 7-MHz dipole will be 1.8 dB plus whatever gain can be attributed to the use of tuned feeders instead of coax feed. The strongest signals will be at right angles to the antenna, but an inverted-vee configuration will provide good coverage in all directions.

On the 10-MHz band, this tuned doublet will be even more effective. It will function as a long "extended double zepp" with a gain of nearly 3 dB as compared to a half-wavelength dipole, and with the greatest signal strength at right angles to the antenna wires.

On the 14-MHz band, the 3.5-MHz tuned doublet functions as two one-wavelength antennas fed with rf currents in phase. This provides a four-leafed-clover radiation pattern with lobes 52 degrees from the line of the wires. (As usual, the inverted-vee configuration will provide coverage in all directions.) The gain in the directions of the lobes should be at least 1 dB.

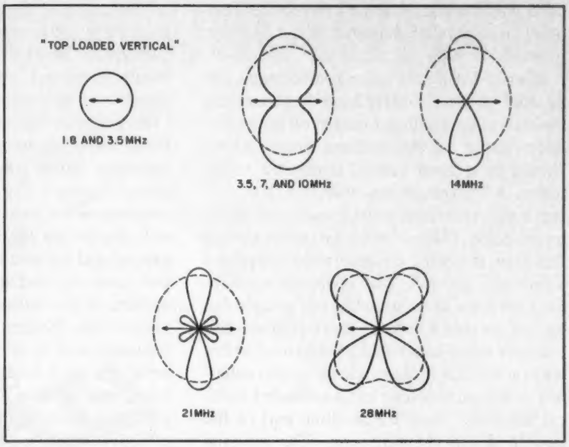

Fig. 3. Approximate directional patterns for antenna number three (33 feet each side of the center). The dotted lines show the patterns when the antenna is in the form of an inverted vee.

On the 18-, 21-, 24-, and 28-MHz bands, there will be four main lobes and two or more minor lobes. As the frequency gets higher, the angles that the four main lobes make with the direction of the wires become smaller and smaller, and minor lobes (at nearly right angles to the wires) appear. On the 21-MHz band, the antenna functions as two 3/2-wavelength antennas with rf currents in phase, and the gain in each major lobe should be at least 1.5 dB.

On the 28-MHz band, the antenna functions as two two-wavelength antennas with currents in phase, with gains in the major lobes of at least 3 dB. (In spite of extensive reading of antenna articles, I have been unable to find gain figures for the 14-, 21-, and 28-MHz bands using the 3.5-MHz tuned-doublet antenna, so the gain figures presented are guesstimates. The actual gains probably would not be less than these figures and might be more. One antenna authority wrote that the gain on the 28-MHz band should be 4 dB in the main lobes.)

Antenna Number Two

A tuned-doublet antenna system does not necessarily have to have its wires any particular length so long as each wire is exactly the same length as the other one. Moreover, a length can be chosen that will favor certain bands. A good length to have each side of the center is 51 feet. This is the length made popular by G5RV. An antenna with 51 feet each side of the center is slightly less effective on the 3.5-, 7-, and 10-MHz bands than the antenna with 66 feet each side of the center, but it is more effective on the 14-MHz band because it is a long (3/4-wavelength) extended-double-zepp antenna with a gain of nearly 3 dB on that band. The antenna sends and receives best at right angles to the antenna wires on the 3.5-, 7-, 10-, and 14-MHz bands. The four-leafed-clover radiation pattern does not develop until it is used on the 21-MHz band.

The gain figures for this antenna on the 3.5-, 7-, 10-, and 14-MHz bands are as follows: 3.5 MHz—none, 7 MHz—1.5 dB (guesstimate), 10 MHz—at least 1.8 dB, and 14 MHz—nearly 3 dB.

On the 21-MHz band, the main lobes would be in a four-leafed-clover pattern with the angles of the lobes 52 degrees from the line of the wires, and the gain in the main lobes estimated to be at least 1.5 dB. There would be a similar pattern on the 28-MHz

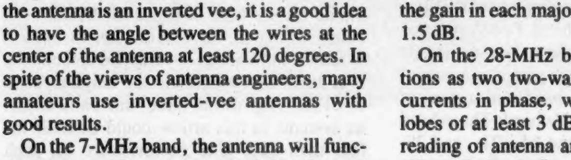
FEEDLINE TO CENTER OF ANTENNA
ANTENNA GROUNDING SWITCH (OUTDOORS OUTSIDE OF THE "SHACK")
TWIN-LEAD
SWR METER
TRANSMITTER WITH T-R SWITCH
ANTENNA TUNER

Fig. 4. The antenna system's connections to the transmitter.

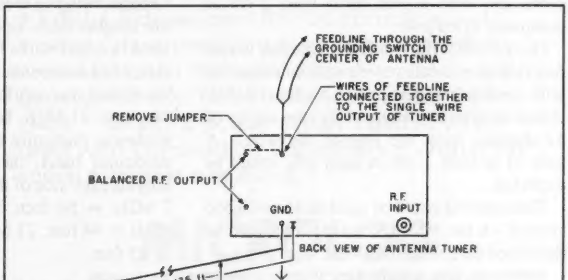
FEEDLINE THROUGH THE GROUNDING SWITCH TO CENTER OF ANTENNA
WIRES OF FEEDLINE CONNECTED TOGETHER TO THE SINGLE WIRE OUTPUT OF TUNER
REMOVE JUMPER
BALANCED R.F. OUTPUT
GND.
R.F. INPUT
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Fig. 5. Connections for using the antennas as top-loaded vertical antennas.

band with the angles of the lobes to the wires being a bit smaller than that of the 21-MHz lobes.

Both of the above-described antennas can be used on the 1.8-MHz band by connecting the ends of the feedline together on the single-wire output of the antenna tuner. There should be a good ground connected to the tuner. A "counterpoise wire," 125 to 135 feet long, connected to the ground post of the tuner, helps. (This wire can be strung along a fence in the yard or otherwise supported above the ground. The counterpoise wire does not have to be stretched out straight but can be located wherever there is space and can have many bends in it.) When used in this way on the 1.8-MHz band, these two antennas will be functioning as "top-loaded vertical antennas" with the feedline part of the system doing the radiating. The antenna wires provide the "top loading." This top-loaded vertical will send well in all directions with perhaps a bit more in the directions of the wires.

Antenna Number Three

Where space is limited, an antenna with shorter wires can be used. This third tuned-doublet antenna has wires 33 feet long on each side of the center. Although it will load up and make contacts on the 3.5-MHz band, it probably would work better as a top-loaded vertical antenna on that band. (This was the experience of N0EVQ.)

On the 7-MHz band, this antenna system functions as a half-wavelength dipole with best directions at right angles to the antenna wires. (An inverted-vee configuration provides coverage in all directions, as is the case with the other two antennas.)

On the 10-MHz band, the antenna could be considered an elongated half-wave dipole or a much shortened "two half waves in phase" with best directivity at right angles to the antenna wires and with some gain as compared to a half-wave dipole.

On the 14-MHz band, the antenna would be "two half waves in phase" with a gain of 1.8 dB as compared to a dipole and best directivity at right angles to the antenna wires.

On the 21-MHz band, the antenna would be two 3/4-wavelength wires fed in phase. This would be an elongated extended double zepp with best directivity at right angles to the wires and with a gain of at least 2 dB as compared to a dipole.

On the 28-MHz band, the antenna would function as two full-wavelength antennas fed with currents in phase and with a four-leafed-clover directivity pattern with lobe angles of 52 degrees from the line of the wires. A gain of at least 1 dB in each lobe could be expected.

This antenna could be used as a top-loaded vertical on the 1.8-MHz band, connected as described earlier in this article.

Although this article has shown how to use these antenna systems on only the eight HF bands that we now have, they will certainly work well on the 18-MHz band after we get it.

When these antennas are used as top-loaded vertical antennas, the gain (or loss) and directivity patterns will vary with each installation. On the 1.8-MHz and 3.5-MHz bands, there will actually be loss as compared to a half-wave dipole for the band. (The antennas will work as top-loaded verticals on other bands, and trying this on the other bands could provide some interesting results.) The effectiveness of these antennas when used as top-loaded verticals will depend on the antenna's height above ground and on how nearly vertical the feedline (now the radiator) is. The higher the antenna is the better, and the more nearly vertical the feedline is the better. Vertical antennas send in all directions. It should be noted that the 1.8-MHz band is a vertical-antenna band because it is extremely difficult to put up a horizontal antenna high enough to be effective on this band (250 feet). As one writer put it, "On the 160-meter band, a horizontal antenna compares favorably with a dummy load."

Choosing Antenna Size

The choice of which nine-band antenna system an operator should build will depend on the space available, which bands are his favorites, and what other antennas, if any, he may have. For example: If space is available and the operator already has a triband beam antenna for the 14-, 21-, and 28-MHz bands, a tuned-doublet antenna system 66 feet each side of the center is the logical choice. It provides 1.8-MHz operation when used as a top-loaded vertical. The 3.5-MHz performance is much better than a coax-fed dipole on that band. The antenna provides a gain of 1.8 dB on the 7-MHz band and a gain of nearly 3 dB on the 10-MHz band. The triband beam can take care of the 14-, 21-, and 28-MHz bands.

If the operator's favorite band is the 14-MHz band and he does not have a beam antenna, the antenna with 51 feet each side of the center is the logical choice. The gain on the 14-MHz band would be nearly 3 dB because the antenna is a long, extended double zepp on that band.

The smallest of the three antennas would be used where there is not enough space for either of the larger antennas. There is nothing sacred about the lengths of 66 feet, 51 feet, and 33 feet each side of the center. Lengths between these can be used as long as the lengths each side of the center are the same. Longer wires favor the lower frequencies. I had an antenna with 40 feet each side of the center that worked very well on the 7-, 14-, and 21-MHz bands. For anyone who wishes to maximize the performance on any particular band, the extended-double-zepp lengths each side of the center are as follows: 7 MHz = 84 feet; 10 MHz = 60 feet; 14 MHz = 44 feet; 21 MHz = 28 feet; 28 MHz = 25 feet.

Using the Tuned-Doublet Antenna System

The antenna system is connected to the transmitter as shown in Fig. 4. The transmitter's output is connected through the T-R switch (built into transceivers and most transmitters) by a short piece of coax to the input of the swr meter. The output of the swr meter is connected to the input of the antenna tuner (or transmatch) by another short piece of coax. The feedline from the antenna is connected to the balanced output of the antenna tuner.

Using low-power output from the transmitter, the antenna tuner is adjusted until the swr meter shows little or no reflected power. The transmitter is next loaded up to the desired power, and the antenna tuner's dials are "touched up" to provide minimum reflected power showing on the swr meter. With a good antenna tuner, it is usually possible to tune up so that there is practically no reflected power. After this has been done, the frequency and tuner settings should be recorded for future use. Finding the correct tuner settings for several frequencies in each amateur band takes time. However, once these frequencies and tuner settings have been recorded, the operator can quickly tune his antenna system to resonance at the desired frequencies by looking at the recorded dial settings.

Conclusions

It would be difficult, if not impossible, to design and build a coax-fed trapped antenna that would work on all nine bands. If such an antenna could be designed, it would have *loss* on each band compared to a half-wave dipole for the band being used. Besides not being very good, the cost of such an antenna would be outrageous. (A trapped antenna for *only three bands* costs in the neighborhood of $130.) Any of the three nine-band antenna systems in this article could be built for less than $50. The performance on each band would be much better than could be obtained from a nine-band coax-fed antenna, even if such could be designed and were available.

If you prefer the *best possible performance*—and don't mind a little extra—then the antenna systems described in this article are for you.

Build one of these antennas, use tuned feeders, and experience the excellent results you can obtain on all bands by using *one* well-designed antenna system. ■

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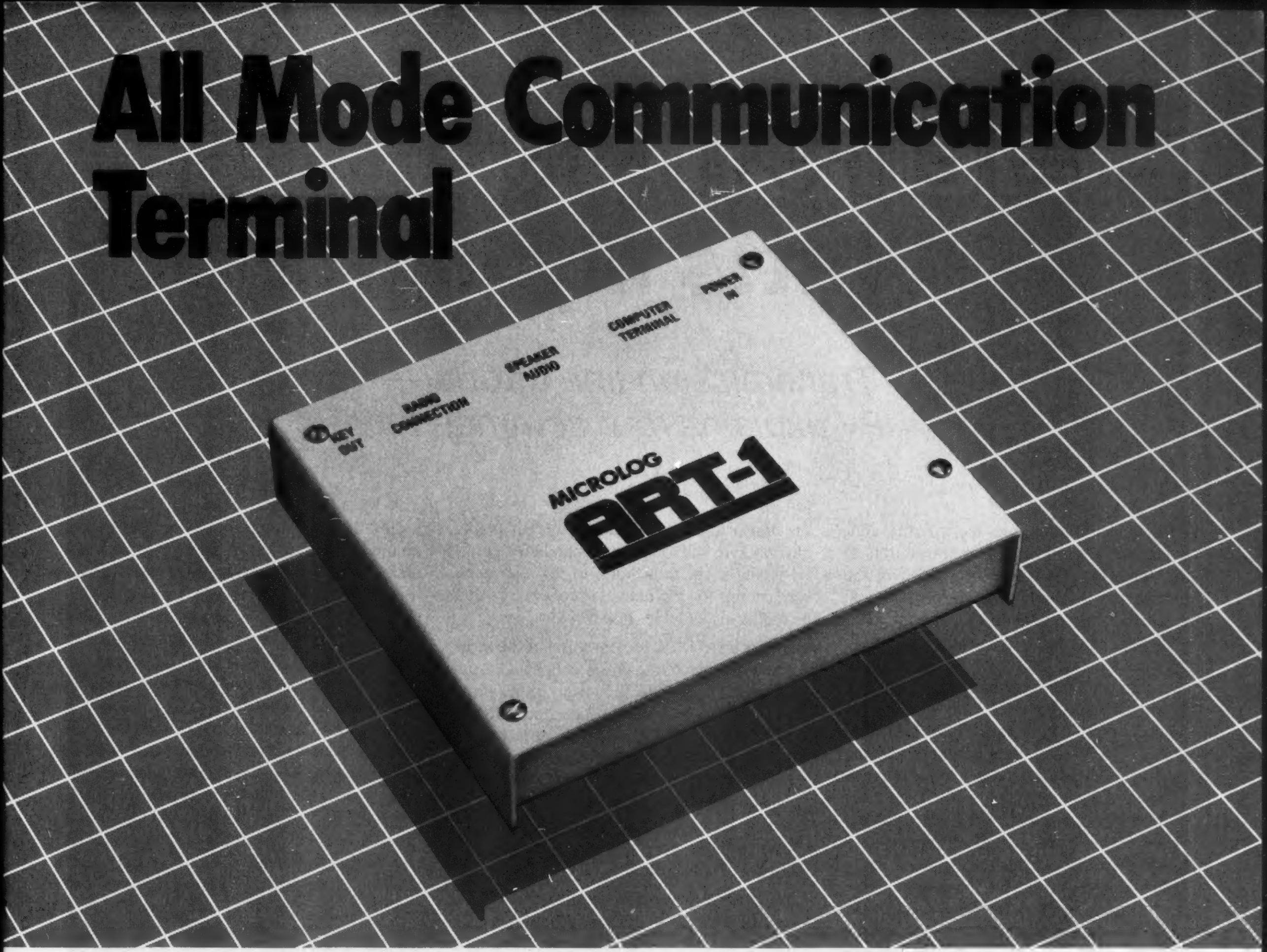
All Mode Communication Terminal



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Watts My Line

Transmission-line tutorial—K4IPV explains four common types.

The transmission line is the wire that connects the output of your transmitter to the antenna or other load. For most of us, the transmission line will be a piece of coaxial cable with a surge impedance of either 52 or 75 Ohms. Fortunately, the antenna manufacturers and transceiver manufacturers conspire with each other to standardize designs. All we normally have to do is connect the standard output of our transmitter to a standard 52- or 75-Ohm coaxial cable and the cable to the standard input at the antenna feedpoint.

Not all of us are able to use standard values, however, and for this type of situation we need to know a little bit about transmission lines. Not much, mind you, but a little. There are, for example, times when we will have to make our own transmission line. That's right, I said *make*! This point was driven home to me recently by a DX contact who is engaged in missionary broadcasting in the wilderness some place or another in Africa. He pointed out that low-budget radio stations often have to make do with local materials, and for him that meant making his own special impedance transmission line for use in a quarter-wave matching section.

You remember the old formula: $Z_o = \sqrt{Z_L Z_S}$? Unfortunately, the value of transmission-line impedance calculated for his situation did not compare favorably with one of the standard values—which weren't available anyway. He had to use the formula for parallel-feeder surge impedance to find appropriate spacing for the diameter conductors that he did have available. It worked!

In this article, I'll look at some of the most common forms of transmission line and show you how to calculate the surge impedance. There also is a program in Basic that will aid in the calculation for four types of transmission line: coaxial cable, parallel feeders, shielded parallel feeders, and VHF/UHF/microwave "microstrip" lines.

Characteristic, or "Surge," Impedance

We frequently bandy about the "impedance" of transmission lines. We refer to 52-Ohm or 75-Ohm coaxial cable, for example. Just what is this impedance? Note that two terms are used for transmission-line impedance: characteristic impedance and surge impedance. As far as I can tell from my literature search, they are the same and so will be used as such here.

The surge impedance of a transmission line is derived from the distributed inductance and capacitance of the line. All forms of transmission lines exhibit these parameters. The capacitance comes from the fact that the two conductors are in close proximity, while the inductance comes from the length of the conductors (no doubt there is also some mutual inductance).

The impedance is $Z_o = \sqrt{L/C}$, where L is the inductance per unit of length in henrys (e.g., H/ft.), and C is the capacitance per unit of length in Farads (e.g., F/ft.).

Note that the impedance is not dependent on length because length appears in both numerator and denominator of the above equation. I have heard supposedly knowledgeable people tell Novices and engineering students that characteristic impedance is measured in "Ohms per foot," and since impedance is resistive in nature it can be measured on an ohmmeter! Horse feathers!

The surge impedance could also be defined in a naive manner by stating that it is the value of terminating resistance (i.e., load impedance) that will not reflect any power back down the line. Thus, when a 75-Ohm transmission line is connected to a 75-Ohm resistive load, none of the forward power is reflected back down the line toward the transmitter.

Coaxial Cable

Perhaps the most widely used transmission line is coaxial cable (see Fig. 1). The name of this transmission line is derived from the fact that the two conductors have the same axis and thus are *co*axial (Fig. 1(a)). The coaxial cable consists of an inner conductor surrounded coaxially by an inner insulator and an outer conductor. An optional outer insulator is also provided on most types (Fig. 1(b)).

The outer conductor is usually braided copper, sometimes tinned and sometimes not. In some special types of coax, however, the outer conductor (or shield) may be aluminum foil (color-TV transmission line), helical armor (like BX electrical cable), or solid pipe (used in some broadcast applications). In the last case, the coax might be fitted with gas-tight flanges and ceramic spacers (internal). That type of coax is used in high-power,

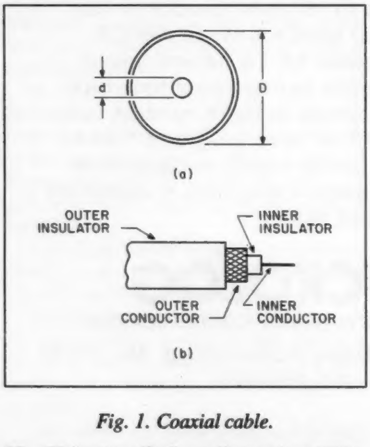

Fig. 1. Coaxial cable.

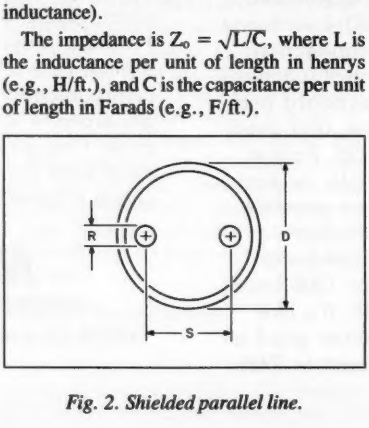

Fig. 2. Shielded parallel line.

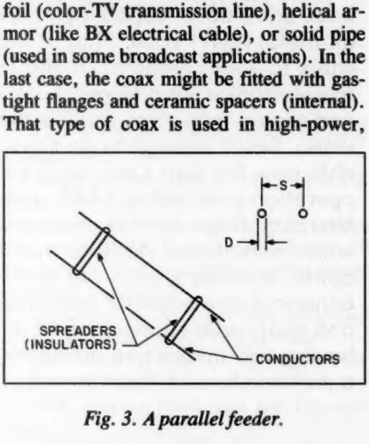

Fig. 3. A parallel feeder.

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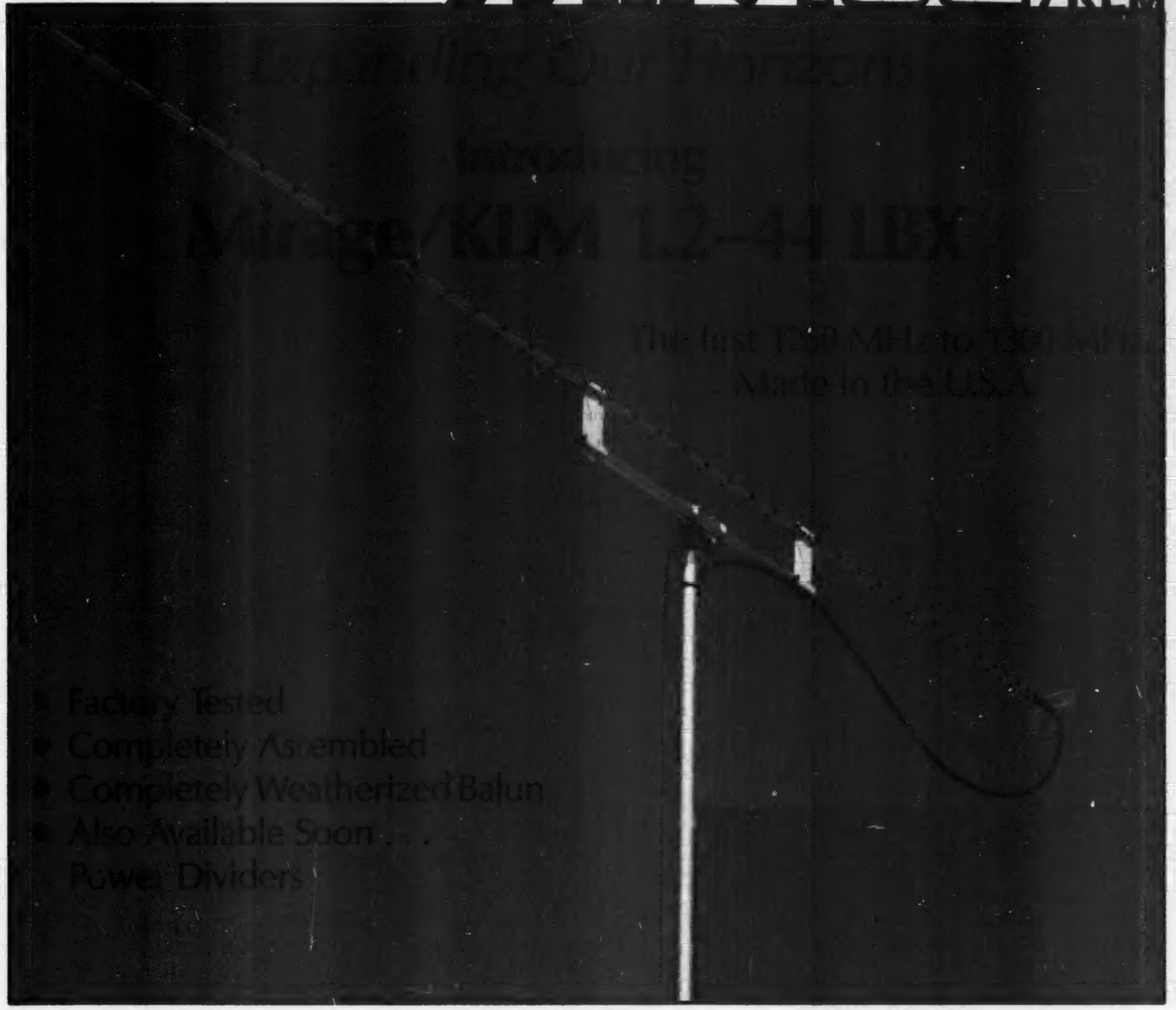

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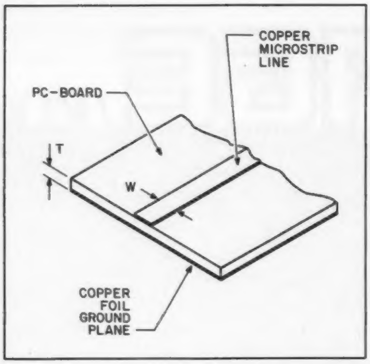

Fig. 4. A common microstrip configuration.

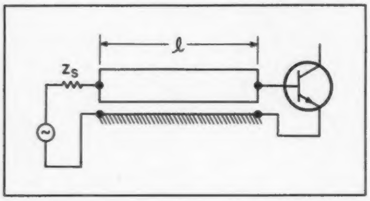

Fig. 5. Schematic representation of a microstrip transmission line.

low-frequency applications, and its dielectric is dried nitrogen gas.

The inner insulator for most types of coax is not quite so exotic, however. Materials such as polyethylene, poly foam, and Teflon™ are used.

One factor affected by the type of inner conductor is the velocity factor (V). This factor is the percentage of the speed of light, expressed as a decimal fraction, that the radio wave travels inside of the coax. Thus, when we say that a foam dielectric coax has a velocity factor of 0.8, we are saying that the radio signal inside the cable propagates at a velocity of 0.8 times the speed of light (0.8C). The velocity factors for common types of coax are 0.66 for polyethylene, 0.80 for poly foam, and 0.70 for Teflon.

The characteristic impedance of coaxial cable is given by $Z_o = (138/\sqrt{E} \times \text{Log}(D/d)$, where $E = 1$ for air, and $1/V^2$ for other dielectrics.

Shielded Parallel Feeders

Shielded parallel feeders are not used extensively by amateurs but are found in television applications. One suspects that users of folded dipoles and certain other types of antennas that are amicable to this form of transmission line might want to consider it because of TVI.

An example of shielded parallel line is shown in Fig. 2. Note that the transmission line consists of two conductors parallel to each other and surrounded by a shielded braid not unlike coaxial cable. The surge impedance of this transmission line is given by $Z_o = (276/\sqrt{E}) \times \text{Log}\{[(1 - B^2)/(1 + B^2)] \times 2A\}$, where $A = S/D$ and $B = S/R$.

Commercial types of shielded parallel lead are available in 300-Ohm surge impedance

Program listing.

```
100  REM  The name of this program is TRANLINE
110  REM  This program calculates the characteristic impedance of four
120  REM  different types of radio transmission line.  See also programs
130  REM  QUARSEC and MATCHING.SEC
140 S = 22
150 Q = 18
160  GOSUB 1970
170 PRINT TAB(S);"* * * * * * * * * * * * * * * * * * * * * *"
180 PRINT TAB(S);"*                                          *"
190 PRINT TAB(S);"*  PROGRAM TO CALCULATE CHARACTERISTIC  *"
200 PRINT TAB(S);"*      IMPEDANCE OF TRANSMISSION LINES    *"
210 PRINT TAB(S);"*                                          *"
220 PRINT TAB(S);"*       Copyright 1983 by J.J. Carr       *"
230 PRINT TAB(S);"*                                          *"
240 PRINT TAB(S);"* * * * * * * * * * * * * * * * * * * * * *"
250 GOSUB 1930
260 GOSUB 2010
270 GOSUB 1970
280 PRINT TAB(Q);"This program will compute the characteristic impedance"
290 PRINT TAB(Q);"cable, parallel (open-wire), parallel-shielded and "
300 PRINT TAB(Q);"parallel (printed circuit) strip-line."
310 GOSUB 1930
320 GOSUB 2010
330 GOSUB 1930
340 PRINT TAB(Q);"SELECT One (1) From Menu Below:"
350 PRINT
360 PRINT TAB(Q);"1.  Two-conductor COAXIAL cable"
370 PRINT TAB(Q);"2.  Parallel Feeders (open-wire)"
380 PRINT TAB(Q);"3.  Shielded Parallel Conductor"
390 PRINT TAB(Q);"4.  Microstrip (PC) Parallel Line"
400 PRINT
410 INPUT "SELECTION?",M
420 ON M GOTO 430, 850, 1140, 1470
430 GOSUB 1930
440 PRINT "COAXIAL CABLE SELECTED"
450 PRINT
460 PRINT "Diameters d and D are to be in SAME UNITS"
470 PRINT
480 INPUT "Diameter of inner conductor (d):";D1
490 PRINT
500 INPUT "Overall outside diameter (D):";D2
510 GOSUB 1930
520 PRINT "Select dielectric material:"
530 PRINT
540 PRINT "1.  Foamed Polyethylene"
550 PRINT "2.  Regular Polyethylene"
560 PRINT "3.  Teflon
570 PRINT "4.  Air-Space Polyethylene"
580 PRINT "5.  Air Insulated"
590 PRINT
600 INPUT "Selection?",S
610 IF S = 1, THEN V = .8
620 IF S = 2, THEN V = .66
630 IF S = 3, THEN V = .7
640 IF S = 4, THEN V = .86
650 IF S = 5, THEN V = 1
660 IF S > 5, THEN GOTO 530
670 E = 1/(V^2)
680 ZA = LOG(D2/D1)
690 ZA = ZA*.4343
700 ZB = 138/(SQR(E))
710 ZO = ZA*ZB
720 ZO = FIX(ZO)
730 PRINT "ZO =";ZO
740 PRINT "E=";E
750 PRINT "V=";V
760 GOSUB 2010
770 PRINT
780 PRINT "1.  Do another COAXIAL CABLE?"
790 PRINT "2.  Select Another Type of Transmission Line?"
800 PRINT "3.  Finished?
810 PRINT
820 INPUT "Selection?",P
830 IF P>3, THEN GOTO 770
840 ON P GOTO 430,330, 2040
850 GOSUB 1930
860 PRINT "PARALLEL OPEN-WIRE FEEDERS SELECTED"
870 GOSUB 1930
880 PRINT "All dimensions in SAME UNITS!"
890 GOSUB 1930
900 GOSUB 2010
910 GOSUB 1930
920 INPUT "ENTER conductor diameter:",D
930 PRINT
940 INPUT "ENTER conductor spacing:",S
950 PRINT
960 ZA = (2*S)/D
970 ZA = LOG(ZA)
980 ZA = .4343*ZA
990 ZO = 276*ZA
1000 PRINT
1010 PRINT "ZO =";ZO
1020 PRINT
1030 PRINT "Velocity factor (V) and Dielectric Constant (E)"
1040 PRINT "defined as 1"
1050 GOSUB 1930
```

```
1060 GOSUB 2010
1070 GOSUB 1930
1080 PRINT "1.  Do Another PARALLEL OPEN-WIRE LINE?"
1090 PRINT "2.  Select Another Type of Transmission Line?"
1100 PRINT "3.  Finished?"
1110 PRINT
1120 INPUT "SELECTION?",P
1130 ON P GOTO 850,330,2040
1140 GOSUB 1930
1150 PRINT "SHIELDED PARALLEL CONDUCTOR SELECTED"
1160 PRINT
1170 PRINT "All Dimensions are to be in SAME UNITS!"
1180 PRINT
1190 INPUT "ENTER CONDUCTOR-to-CONDUCTOR SPACING:",H
1200 PRINT
1210 INPUT "ENTER INNER CONDUCTOR DIAMETER:",D1
1220 PRINT
1230 INPUT "ENTER OUTER-SHIELD DIAMETER:", D2
1240 PRINT
1250 B = H/D2
1260 A = H/D1
1270 C = 2*A*((1-B^2)/(1+B^2))
1280 F = LOG(C)
1290 F = .4343*F
1300 V = .8
1310 E = 1/SQR(V)
1320 ZO = (276*F)/SQR(E)
1330 PRINT
1340 PRINT "ZO =";ZO
1350 PRINT "V =";V
1360 PRINT "E =";E
1370 PRINT
1380 GOSUB 2010
1390 GOSUB 1930
1400 PRINT "1.  Do Another Shieled Parallel Conductor Line?"
1410 PRINT "2.  Select Another Type of Transmission Line"
1420 PRINT "3.  Finished?"
1430 PRINT
1440 INPUT "SELECTION?",M
1450 IF M > 3, THEN GOTO 1390
1460 ON M GOTO 1140,330, 2040
1470 GOSUB 1930
1480 PRINT "MICROSTRIP (Printed Circuit) LINE SELECTED"
1490 GOSUB  1930
1500 PRINT "All Dimensions Must be in SAME UNITS!"
1510 GOSUB 1930
1520 GOSUB 2010
1530 GOSUB 1930
1540 INPUT "ENTER printed circuit board thickness:",T
1550 GOSUB 1930
1560 INPUT "ENTER conductor width:",W
1570 GOSUB 1930
1580 PRINT "Select BOARD TYPE:"
1590 PRINT
1600 PRINT "1.  Glass-Epoxy"
1610 PRINT "2.  Teflon-loaded Glass"
1620 PRINT
1630 PRINT
1640 INPUT "SELECTION?",G
1650 IF G > 2, THEN GOTO 1570
1660 IF G = 1, THEN E = 4.8 ELSE E = 2.5
1670 ZA = W*(SQR(E))
1680 ZB = T/ZA
1690 ZO = 377*ZB
1700 K = (W/T)^-.836
1710 L = 1.735*(E^-.724)
1720 J = K*L
1730 Y = 1+J
1740 ZO = ZO/Y
1750 ZO = FIX(ZO)
1760 GOSUB 1930
1770 PRINT "ZO =";ZO
1780 PRINT "Width (W):";W
1790 PRINT "Board Thickness (T):";T
1800 IF G = 2, THEN GOTO 1830
1810 PRINT "E =";E;" for Glass-Epoxy Boards
1820 GOTO 1840
1830 PRINT "E =";E;" for Teflon-loaded Glass boards"
1840 GOSUB 2010
1850 GOSUB 1930
1860 PRINT "1.  Do Another Microstrip Line?"
1870 PRINT "2.  Select Another Type of Line?"
1880 PRINT "3.  Finished?"
1890 PRINT
1900 INPUT "SELECTION?",P
1910 IF P > 3, THEN GOTO 1850
1920 ON P GOTO 1470,330, 2040
1930 FOR I = 1 TO 5
1940 PRINT
1950 NEXT I
1960 RETURN
1970 FOR I = 1 TO 30
1980 PRINT
1990 NEXT I
2000 RETURN
2010 PRINT "Press ANY key to continue:"
2020 A$=INKEY$: IF A$="" THEN 2020
2030 RETURN
2040 PRINT "end"
```

capable of delivering several hundred Watts to the antenna. I have found that this kind of line gets too warm when a kilowatt is used. While that experience is almost two decades old by now, I have little reason to believe that a strictly television-reception type of line will perform effectively on a high-power transmitter antenna. With a standard 100–200-Watt transceiver, however, there will be little problem provided that impedance matching at the feed end of the line is done correctly.

Parallel Feeders

This is the type of transmission line spoken of by my DX contact in Africa (see Fig. 3). This was the first type of line used by amateurs that wasn't a simple length of wire indistinguishable from the antenna itself! The line consists of two parallel inductors separated by an insulator—usually air, in amateur transmission lines. (TV twinlead is the same sort but uses vinyl insulation.)

Amateurs typically use solid or stranded wire for the conductors, except when making certain matching sections and ceramic spreaders for insulators. I have seen spreaders sold with several notches for the conductors along the length so that distance between the conductors can be varied to obtain a specific impedance value. There are two versions of the formula, but the simplified case, that assumes an air dielectric, is $Z_o = 276\mathrm{Log}(S/D)$.

Parallel feeders can be built for almost any practical impedance that you might need. In most cases, we will know the impedance and can select standard diameters for the conductors from available stock. In that case, we will want to solve the above equation for the spacing, S, which is exactly what most texts delete: $S = D10^{Z_o/276}$, where D is the conductor diameter, Z_o is the desired impedance, and S is the spacing. (S and D must be specified in the same units, e.g., feet, meters, inches.)

Microstrip Line

Microstrip line is a form of transmission line used at VHF, UHF, and microwave. It is formed on printed circuit boards (see Fig. 4). This transmission line is formed from an etched conductor on the board surface counterpoised against a copper-foil ground plane on the other side of the board. Obviously, double-sided board is needed. The characteristic impedance is given by $Z_o = (377/\sqrt{E_t})$ x (T/W), where Z_o is the characteristic impedance, W is the conductor width, T is the board thickness, and E_t is the dielectric constant of the board material. Fig. 5 shows a typical use of a microstrip line in a UHF or microwave amplifier.

Computer Program

A computer program for the impedance equations used in this article is shown in the listing. This program is in the MS-DOS Basic used in the IBM PC and should be compatible with other Microsoft Basics. In any event, the program is easily translatable for other Basics—something I had in mind since I have both Apple and IBM PC computers. ■

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Tulsa OK 74114

Scaling the Wet Noodle

It's ham radio's equivalent of a ship in a bottle: Evaluate your antenna's design with a quarter-scale model.

Have you ever had an idea for a new antenna system and would like to know how well it might perform without doing too much work? Then consider reducing the antenna's size, so you can modify and test it without wearing yourself out raising and lowering the brute. Fortunately, the amateur frequency assignments are almost ideal for scale models. Scale modeling is accomplished by reducing the size of the antenna by some scale factor, then increasing the test frequency by this same factor. For example, a one-quarter-scale model of a 160-meter antenna can be tested on the 40-meter band (4 x 1.8 MHz = 7.2 MHz). With a little more ciphering, you can determine all other possible combinations.

Wanting to get on 160 meters, but not having the real estate necessary to erect an inverted vee or a dipole, I was stuck with putting up some kind of vertical that would be reasonably efficient and small in size (these aren't very compatible). Since I have had some experience in designing top-loaded vertical antennas, I came up with the idea of utilizing both capacitive and inductive top loading (not original by any means).

After scouting around a little, I located a source of 20-foot sections of fiberglass pipe varying in diameter from 1.5 inches to 3 inches; they could be telescoped. This looked like an ideal mast for what I had in mind.

For the capacitance hat, I thought I might use several spokes made from small-diameter aluminum tubing, mounted on a disk/hub assembly that could be bolted to the top of the fiberglass mast. The loading coil could then be wound on the mast slightly below this capacitance hat.

Now came the design problem: How much inductance would be required to resonate this structure in the middle of the 160-meter band? I could see myself raising and lowering the antenna several times, using the old "try and try again" technique. Here my 70-year-old friend Willie W5FXP came to the rescue by suggesting I build and test a quarter-scale model. Willie, as usual, was quite persistent. So, since he was willing to help, why not?

For the full-scale model inductor and antenna wire, I had located an inexpensive source of industrial-grade insulated solid-copper wire (#12 THHN). This wire with insulation was approximately 1/8 inch in diameter. Dividing this by 4 produced a scale-model wire diameter of 0.03125 inches,

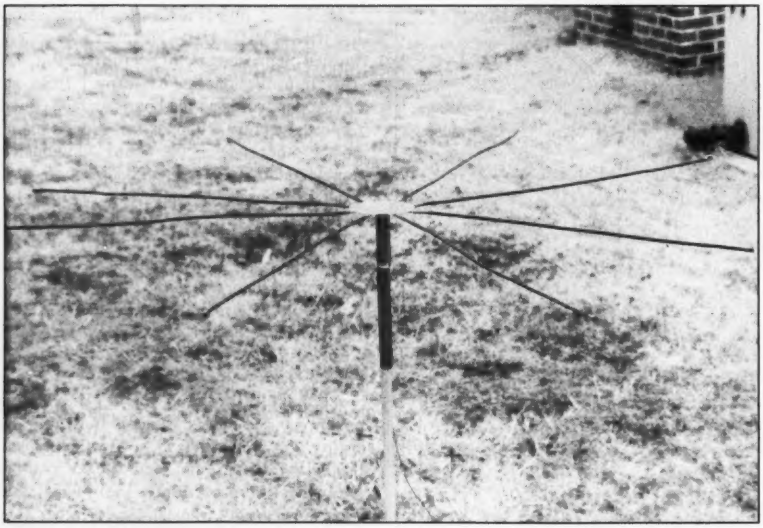

Photo A. Bird's-eye view of the quarter-scale top hat and loading coil.

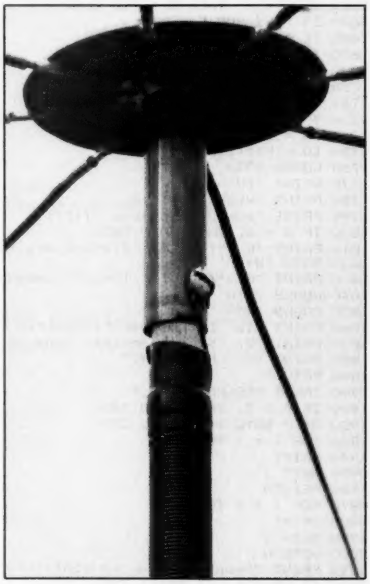

Photo B. Construction details of the quarter-scale top hat.

Photo C. Quarter-scale antenna held by full-scale W5RRH. The full-scale antenna mast can be seen in the background.

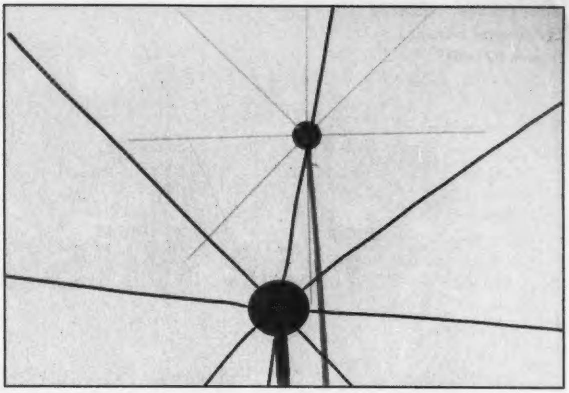

Photo D. Quarter-scale and full-scale top hats and loading coils.

about the same as #20 wire. We figured this should be suitable for the quarter-scale model inductor and antenna wire.

I had decided on using the 1.5-inch fiberglass pipe for the full-scale mast, sliding this into a short piece of 2-inch fiberglass pipe which would be set in concrete. This would give me an overall mast height of approximately 25 feet. Scaling this down by a quarter dictated a coil form 1/2 inch in diameter, and a mast 6 feet 3 inches high.

Next came the capacitance hat. For the full-scale model, I had acquired four 12-foot sections of 1/2-inch aluminum tubing. Cutting these in half would provide eight "spokes," each 6 feet in length. For mounting, a 6-inch-long 2.062-inch-i.d. aluminum tube was welded to the center of a 12-inch-diameter aluminum disk. This tubing would slide down over the top of the 2-inch-o.d. fiberglass mast. The spokes could then be bolted on the top of this disk.

The scale-model spokes needed to be 0.125 inches in diameter and 1.5 feet long. Not having any #8 wire (0.128-inch-diameter), we decided to use the #12 wire instead, knowing this would provide slightly less top-hat capacitance. A 3-inch-diameter piece of copperclad circuit board became the scale-model disk, and a piece of 1/2-inch thin-wall copper pipe became the scale-model mounting tube. All of these scale-model pieces were soldered in place.

The scale-model loading coil was wound on a 1/2-inch-diameter wood dowel rod. After much discussion, Willie and I decided to start out with 150 turns. We estimated that this would be a few turns too many—but it is always easier to take off than to add on. The quarter-scale model was assembled and mounted such that the capacitance hat was exactly 6 feet 3 inches above a good ground, this being a radial ground system consisting of 32 radials varying in length from 20 to 45 feet. These were the maximum lengths possible, without encroaching on the XYL's flower beds or the neighbors' yards.

Using a grid-dip oscillator, we determined that the resonant frequency was a little too low, the target being 7.2 MHz. After several cycles of "remove a few turns and try again," we ended up with 111 turns. The next step was to see how well the antenna performed, so we connected some RG-8 coax cable from the scale-model antenna and ground system to my HF transceiver. All indications were that we hit everything right on the money. The impedance was quite low (swr approximately 4:1), but with the aid of a coupler I was able to load up to full power.

Since it was getting late in the day, we decided to cease the proceedings. Besides, Willie wanted to see what kind of signal this little antenna would put out over at his house (about a mile away). Willie rushed home and got on the air. Not only did he report an S9 +40 signal, but we also made contact with two other stations, George K7DY in Tucson and Bill W4KFB in Louisville. George gave me a 5-8 report and Bill a 5-9. Needless to say, there was considerable discussion about my miniature antenna.

Next came the "proof of the pudding." Using the material described previously, we assembled the 25-foot full-scale model. Since the quarter-scale model was resonant at 7.2 MHz, we estimated that the same number of turns on the full-scale model loading coil would resonate the antenna at approximately 1.8 MHz, which is too low for practical purposes. After a little discussion, we decided that 105 turns would be about right, but added another five for good measure. This proved to be a mistake because we had to take it all down and remove those five turns.

The full-scale antenna performed about as we had expected. Again, the impedance was quite low. We estimated that the radiation resistance was about 1 Ohm and the ground-loss resistance about 11 Ohms. Willie suggested that I use a 4-to-1 bifilar-wound toroid transformer at the base of the mast to step the impedance up to approximately 50 Ohms. This worked exceptionally well, the swr being 1:1 at the resonant frequency.

After this success, I got a little greedy and decided to add another 20 feet to the height. A 20-foot section of 2.5-inch fiberglass pipe was acquired and plans made to extend the structure accordingly. Naturally, at the insistence of Willie, we had to do the scale modeling again. It was a good thing we did, however, because we discovered that another 10 turns had to be removed from the loading coil to make everything close to the same resonant frequency.

Erecting the 45-foot full-scale model was quite an experience. With Willie holding the base on the ground against the concrete-mounted short mast, I started the usual "walk-up" procedure. After I reached the midpoint, I looked around and discovered the top hat had barely cleared the ground. Due to the antenna's conflict with a small tree, I had to let it back down and start over again. Unfortunately, unknown to us, one of the top-hat spokes was put into a bind and cracked right at the outer mounting bolt. After we moved the structure so that it would clear the tree, back up it went. Willie said that the base of the mast was up about 50 to 60 degrees before the top started up, then it really got with it.

After reaching the vertical, the top hat waved around as if it were mounted on a wet noodle! Having anticipated this undesirable flexibility, I had attached two levels of guy ropes to the mast. After we slipped the mast over the ground post and bolted it in place (another struggle), we adjusted the guy ropes until Willie was satisfied everything was vertical and straight. Eventually, the cracked spoke fell off, but we weren't about to let the antenna back down just to replace one spoke. This reduced the top-hat capacitance, increasing the resonant frequency about 30 kHz—which was where I really wanted it anyway (about 1.885 MHz).

If you want to see a seven-spoke top hat and a 105-turn top-loading coil supported by a 45-foot wet noodle, come on by. It does get me on 160 meters, however. If I were going to do it again, I think I would use either larger diameter fiberglass pipe or, even better, large diameter aluminum tubing for the main part of the mast, then use a short section of fiberglass or PVC pipe for the loading coil. Oh well, hindsight is always better. At any rate, the scale modeling was quite interesting. As Willie said, "Besides, it was FUN!"■

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The Missing Link?

Work the world with your HT using WB2REM's simplex controller.

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Motivated by feelings that all hams have experienced, I became obsessed with the idea of communicating worldwide with only a hand-held VHF/UHF transceiver. Thus, I designed a remote link that changed my VHF/UHF operations and one that will bring excitement to yours.

Can you picture yourself riding a bicycle in the neighborhood, or even miles away, and QSOing with someone on the other side of the USA or the world? Do you drive a lot and are you tired of the mundane operations of 2 meters but do not have the room for an HF rig? Are you a DX buff and do you have anxiety attacks over missing rare DX stations while you are at work? Then this project is for you!

As a prerequisite for this project you will need a simplex autopatch or similar device, touchtone™ decoder, UHF or VHF transceiver, as well as an HF rig. Knowledge of digital electronics is needed, although I was initially very naive on the subject and learned by trial and error.

My first working link design employed three Radio Shack 22/44-pin printed-circuit-board cards. In addition to related circuitry, over ten relays were spread out among the boards. After further consideration, I employed a 7420 (TTL-4 input NAND gate), which replaced many of my relays. The newest revision, reported in this article, is contained on one Radio Shack 22/44-pin board and will enable you to operate your HF rig at your house by using just your VHF/UHF HT or mobile transceiver.

The simplex link requires a simpatch sampling device. I chose the CES 510SA because of its special access features, especially the line-in-use code option. That option allows you to interrupt a telephone call in progress only by inputting a three-digit touchtone code from your remote transceiver. These codes can be manipulated to activate the link. This link was designed for use with the CES 510SA Revision B, although instructions are given for Revisions C, D, and E. Other types of simplex autopatches can be used as well with special modifications. It is also advisable that you use a fast-switching VHF/UHF rig in conjunction with the simpatch. Besides the HF rig (which can be any type), a DTMF decoder (like a Silicon System SS 202P) will be needed. Outputs of the DTMF decoder should be 5 volts.

The block diagram (Fig. 1) illustrates the operations of the simplex link system. Basically, a touchtone signal originating from your remote transceiver is received by the VHF/UHF transceiver connected to the link. The signal is passed through the touchtone decoder, causing a voltage shift from +5 V to ground while the touchtone is present. These voltage shifts in turn send messages to the ICs and relays, which activate the link.

The link performs a number of functions. It supplies power to your low-band rigs and controls your mode of operation. The link turns on in a receive-only mode. This will allow you to chat on your VHF/UHF HT while monitoring the HF band in the background. The patch silences the HF receiver audio when you transmit on your HT. Through touchtone commands you can switch into a transceive mode. Here, all signals received by your VHF/UHF transceiver are simultaneously transmitted on the HF band. A beep follows your transmission to verify your HF transmission. Finally, the link switches out the phone line and reinserts the HF-receiver audio into its place.

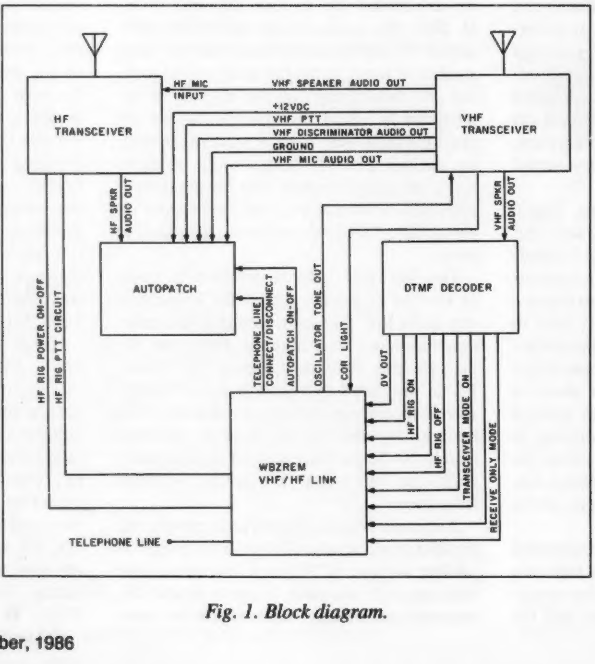

Fig. 1. Block diagram.

Circuitry

Electrically, the link consists of two 2-tone latches composed of: three 7400s, a 7420, two 556 timers, an oscillator, three 5-volt relays, and one 12-volt relay. All components are mounted on the Radio Shack 22/44-pin board except for RL1, the 12-V relay. Photo A shows how tight the fit is. All ICs and relays should be mounted as close to each other as possible on the 22/44-pin board. One of the 2-tone latched circuits is used to trigger the 4PDT relay (RL1), which turns the HF rig on, disconnects the telephone line, and inserts HF-receiver audio. The other switches the link from receive to transceive mode.

At the central core of the link is the 7420 (U5), a 4-input NAND gate. When each of the four inputs of this IC simultaneously receives a +5-volt signal, a relay (RL3) is activated, which triggers the PTT switch of your HF rig.

Pin 1 of the 7420 is connected to the output (pin 3) of one of the 2-tone latches (U3). The latch output is at ground potential until triggered by the transceive-mode touchtone access code. The output then shifts to +5 volts. LEDs connected to the inputs of the 7420 indicate the presence of input signals. In returning to receive-only mode, the output of U3 drops back down to ground.

Pin 2 of the 7420 is connected to the output of a 74123 (a monostable multivibrator). It sounds obscene but is merely a timer. In the link this output is normally at +5 volts, but it shifts to ground potential for one second when triggered by DV. DV is a line that comes out of most touchtone decoders and responds to every valid touchtone by shifting to +5 volts for as long as a tone is present. This circuitry in the link is used to mute the transmission of touchtones over the HF band and, in effect, momentarily takes the HF rig out of transmit when a touchtone is decoded. I have found that DV and/or the decoder is

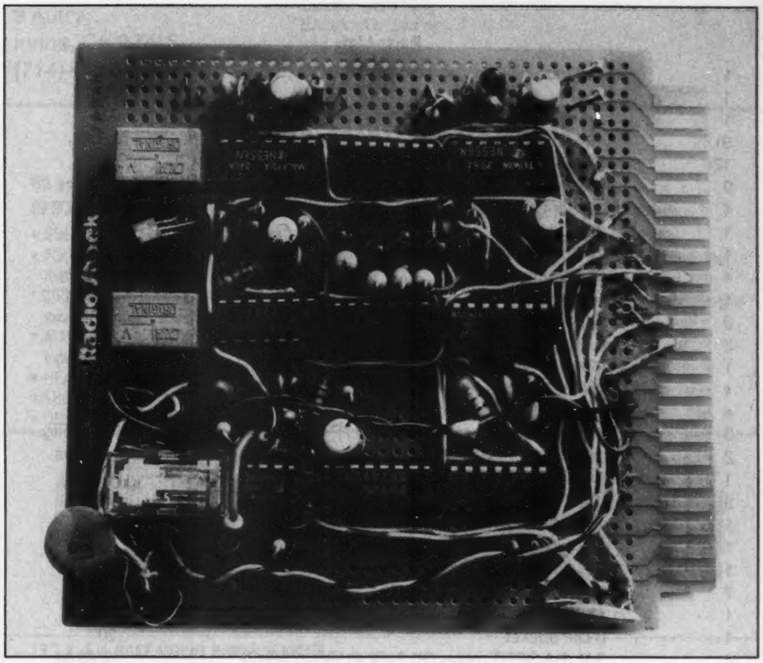
Radio Shack

Photo A. A complete simplex link on one tiny board.

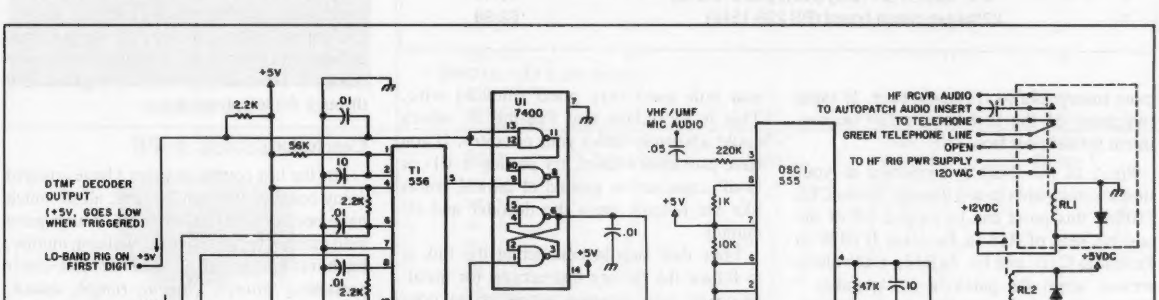
DTMF DECODER OUTPUT (+5V, GOES LOW WHEN TRIGGERED)
LO-BAND RIG ON FIRST DIGIT
SECOND DIGIT
LO-BAND RIG OFF FIRST DIGIT
SECOND DIGIT
TRANSCEIVE MODE ON FIRST DIGIT
SECOND DIGIT
RECEIVE ONLY MODE ON FIRST DIGIT
SECOND DIGIT
DV OUT
+5V
2.2K
56K
.01
10
330K
74123 MULTI-VIBRATOR
T1 556
T2 556
U1 7400
U2 7400
U3 7400
VHF/UHF MIC AUDIO
.05
220K
1K
10K
OSC 1 555
U5 7420
330(4)
U4 7404
+12V
4.7K
AUTOPATCH ON (IF +5V, OMIT 4.7K AND 2.2K RESISTORS)
HF RCVR AUDIO
TO AUTOPATCH AUDIO INSERT
TO TELEPHONE
GREEN TELEPHONE LINE
OPEN
TO HF RIG PWR SUPPLY
120VAC
+12VDC
RL1
+5VDC
RL2
47K
Q1 2N2222
R1 4.7K
HF RIG PTT CIRCUIT
A
B
RL3
Q2 2N2222
RL4
Q3 2N2222
UHF/VHF TRANSCEIVER COR LIGHT

Fig. 2. Schematic of the WB2REM low-band link.

Parts List

1	1 uF non-polarized electrolytic	.79
1	.1 uF	.25
1	.05 uF	.25
5	10 uF tantalum	.69 ea.
12	.01 uF	.10 ea.
9	2.2k, 1/4 W	.10 ea.
4	56k, 1/4 W	.10 ea.
1	330k, 1/4 W	.10
1	220k, 1/4 W	.10
4	330 Ohms, 1/4 W	.10 ea.
1	10k, 1/4 W	.10
3	1k, 1/4 W	.10 ea.
2	4.7k, 1/4 W	.10 ea
1	47k, 1/4 W	.10
4	1N4004 diodes	.15 ea.
4	Red LEDs	.20 ea.
3	2N2222 transistors (RS 276-1617)	$1.98/pkg.
2	556 ICs (T1, T2) (RS 276-1728)	$1.49 ea.
1	74123 IC	$1.50
3	7400 ICs (U1, U2, U3) (RS 276-1801)	.89 ea.
1	7404 IC (U4) (RS 276-1802)	.99
1	7420 IC (U5)	.99
1	555 IC (OSC1) (RS 276-1723)	$1.19
7	14-DIP sockets	.20 ea.
1	16-DIP socket	.20
1	8-DIP socket	.20
2	5-V, 2-A SPDT relays (RL2–RL4) (RS 275-243)	$2.49 ea.
1	5-V, 1-A DPDT relay (RL3) (RS 275-215)	$3.99
1	12-V, 10-A 4PDT relay (RL1) (RS 275-218)	$5.49
1	22/44-pin circuit board (RS 276-154a)	$2.99

most susceptible to rf interference. If rapid switching of the low-band relay occurs, shield the decoder from rf.

Pin 5 of the 7420 is connected to your simplex-autopatch in-use voltage. In the CES 510SA, this point can be tapped off of the positive side of R18 in Revision B (R29 in Revisions C, D, and E). At R18, +12 volts is present when the patch is in "standby." When activated, it drops to ground potential. This shift is inverted by the 7404 and applies 5 V to pin 5 of the 7420.

Finally, from a connection to the squelch, COR light, or other carrier-sensing device coming from your VHF/UHF transceiver, you will need to use that voltage to drive a 5-V relay. This relay's normally open contacts will then apply 5 V on pin 4 of the 7420 whenever a signal breaks the squelch of your VHF/UHF rig.

Once all four conditions are met, relay RL3 will short the push-to-talk wires of your HF rig and put it into transmit. A beep will come back after you stop transmitting. This beep is generated by the 555 (OSC1) oscillator. The length of the beep can be changed by varying *R1 or C1*, the tone pitch by *R2 or C2*, and volume by changing R3. If you cannot immediately hear the beep, open your remote transceiver's squelch. The beep may be coming back too quickly.

Hookup

Refer to Fig. 1, the block diagram. To interconnect your VHF/UHF base station to the simplex autopatch and HF rig, you will need very good shielded wire. This is to reduce any floating rf, which could adversely affect your circuitry. If you have problems with rf, try putting a .01- or .1-uF capacitor to ground at critical points like the outputs from the decoder and IC outputs.

Your first step in connecting the link is to follow the factory instructions for installation of your simplex autopatch to your VHF/UHF rig. Next, you should connect a shielded wire from the receiver audio of your VHF/UHF rig and run it to the microphone audio line of your low-band rig. I was able to make this connection directly, but you may need an audio transformer in the circuit. Next, run shielded wire from the HF-rig push-to-talk line to the normally open and common contacts of the DPDT (RL3) relay. From the receiver audio line of the HF rig, run a shielded wire to the audio insert point in your simplex autopatch. This is done through a 1-uF capacitor. In the CES 510SA Revision B, this connection is made between T1 and C18 (C22 in Revisions C, D, and E).

Testing the Link

To activate the link, key in the "line in use" and "autopatch on" touchtone codes on your VHF/UHF remote transceiver and set your decoder's output with them. These codes cause relay RL2 to switch relay RL1. Relay RL1 has several functions: It supplies power to your HF rig, disconnects the telephone line from the autopatch, and switches the HF-rig receiver audio into the autopatch. The HF audio will be heard through the normal simplex autopatch sampling method. Adjust the audio level of your HF rig by listening on your remote transceiver (HT). You will find that the volume adjustment should be lower than normal listening level. To go into transceive mode, key in your designated touchtone codes. There will be a slight delay (1/4 to 1/2 second) and your HF PTT will be activated. Talk into your remote transceiver (HT) and adjust your low-band microphone level at the same time as reducing or increasing the VHF/UHF rig receiver level. This will ensure a proper HF-band modulation level. If your microphone gain is too high, it may affect the operation of the decoder. So, if you notice that the touchtones aren't muting on the HF band, lower your HF-band microphone gain and/or increase VHF/UHF receiver gain.

It must be noted that, in this type of link operation, extreme courtesy should be exercised. Since you will probably be able to operate only on one HF frequency (unless you have a computer-controlled transceiver), you should always ask if the frequency is in use, as in normal operation. This applies to your VHF/UHF simplex frequency as well.

Secondly, in accordance with FCC rules and regulations, you should have a separate control link to your setup. I use a telephone-line control system, which you can purchase at Radio Shack or Sears. It turns my complete station's electricity on/off by signals sent through the telephone line.

Conclusion

For the last couple of years I have enjoyed many contacts through the link, all of which have been exciting experiences. I have gone auto mobile, bicycle mobile, walking mobile, barbershop portable, and dentist-chair portable. [*"Mumph glumph, rumph, aaack, ouch—Please rinse and spit" echoing through the HF bands.—Ed.*] The implications for use in emergency situations, retirement communities, and apartments are unlimited.

I view linking as a new frontier in amateur radio. The possibilities are limitless as to where, how, and with whom it can be done. You can link 220 MHz to 2 meters, or 440 FM to 15-meter SSB. Most importantly, it is done on simplex and does not tie up a repeater.

So get out in the air, take a ride in the country, or just lie on the beach because now you can rest assured that if you get the sudden urge to call CQ DX, your big rig is as close as your HT.

At this time I would like to thank Dick Spair K2ASG, whose expert skills regarding linking provided me with the backbone for writing this article. I would also like to thank Jerry Lutin N2ERB, who painstakingly transcribed my chicken-scratch schematics into a work of art. In addition, I would like to acknowledge Dick Maly N2COH, Mark Winderman WA2HCS, and Lou Cordas K2EWT for their invaluable help. ■

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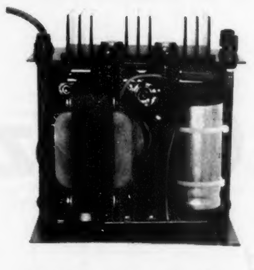

INSIDE VIEW — RS-12A

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MODEL RS-50M

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RM-50A	37	50	5¼ × 19 × 12½	50
• SEPARATE VOLT & AMP METERS				
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50

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MODEL RS-7A

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W X D	Shipping Wt (lbs)
RS-4A	3	4	3¾ x 6½ x 9	5
RS-7A	5	7	3¾ x 6½ x 9	9
RS-7B	5	7	4 × 7½ × 10¾	10
RS-10A	7.5	10	4 x 7½ x 10¾	11
RS-12A	9	12	4½ x 8 x 9	13
RS-20A	16	20	5 x 9 x 10½	18
RS-35A	25	35	5 x 11 x 11	27
RS-50A	37	50	6 x 13¾ x 11	46

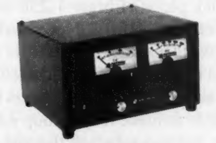
RS-M SERIES

MODEL RS-35M

- Switchable volt and Amp meter

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt (lbs)
RS-12M	9	12	4½ x 8 x 9	13
RS-20M	16	20	5 x 9 x 10½	18
RS-35M	25	35	5 x 11 x 11	27
RS-50M	37	50	6 x 13¾ x 11	46

VS-M SERIES

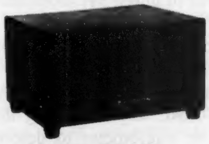


MODEL VS-20M

- Seperate Volt and Amp Meters
- Output Voltage adjustable from 2-15 volts
- Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H x W x D	Shipping Wt (lbs)
VS-20M	16	9	4	20	5 x 9 x 10½	20
VS-35M	25	15	7	35	5 x 11 x 11	29
VS-50M	37	22	10	50	6 x 13¾ x 11	46

RS-S SERIES



MODEL RS-12S

- Built in speaker

MODEL	Continous Duty (Amps)	ICS* Amps	Size (IN) H x W x D	Shipping Wt (lbs)
RS-7S	5	7	4 x 7½ x 10¾	10
RS-10S	7.5	10	4 x 7½ x 10¾	12
RS-10L(For LTR)	7.5	10	4 × 9 × 13	13
RS-12S	9	12	4½ x 8 x 9	13
RS-20S	16	20	5 x 9 x 10½	18

C. L. Houghton
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San Diego CA 92119

Dishing It Out On 10 GHz

Learn how to build simple feed systems for microwave antennas. (Includes an explanation of the mysterious "baggies" effect.)

I have always been mystified by antennas and feeds for use on microwave frequencies. I used to think that most of the technology that is needed is far too advanced for me to tackle—and this held me back from constructing units for myself. The black-box technology held the most mystery for me. I hope in this article to dispel any fears on the very special black-box designs needed to make these antennas work. The techniques that I will present cover designs I have built and used. While there is a degree of black-box magic going on, it did not prevent me from obtaining some very efficient antennas with very simple tools.

I started this project by constructing an antenna feed for 10 GHz before I even contemplated any receiver or transmitter, since I had obtained the piece of waveguide first. Being a scrounger, I couldn't refuse a part that could be put to use sooner or later.

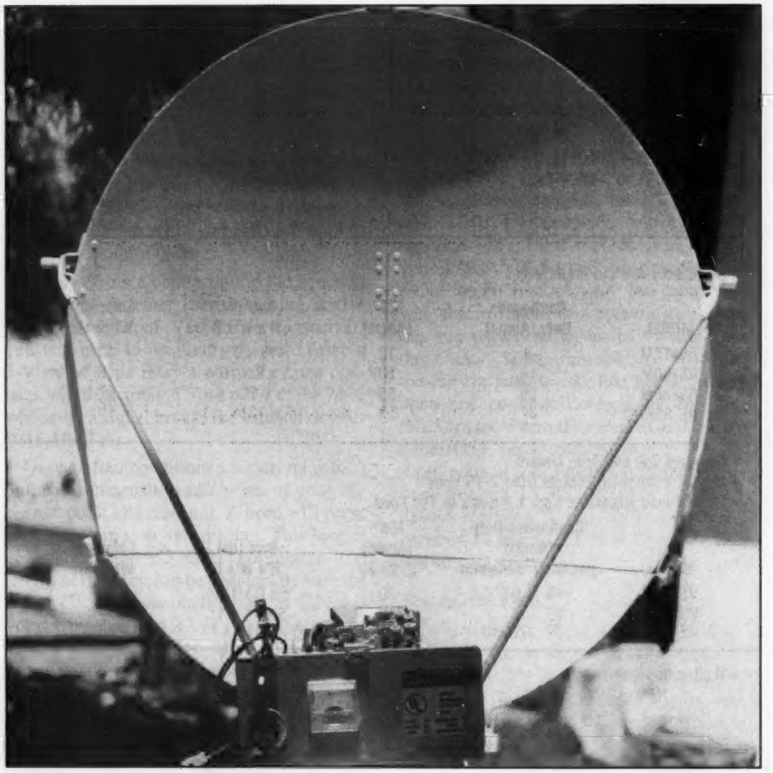

Photo A. Off-center-feed 10-GHz dish with original transceiver mounted at focus. Used for Mount Soledad to Mount Helix contacts.

Dipole Feed

The first feed that I constructed was a simple dipole feed equipped with a reflector spaced behind the driven element. This feed was constructed from one shown in the *RSGB VHF Handbook*. Fig. 1 shows the details. The actual construction of this feed was started on a scrap piece of waveguide 16 (WG-16), which has dimensions of .5 by 1 inch outside and .4 by .9 inches inside. This piece of waveguide was cut back for a distance of 2 inches from the front with a .125-inch edge lip clearance. The triangular area was cut away with a hacksaw and then filed down to the scribe marks as shown in Fig. 1. This vee cut is made in the .5-inch side of the waveguide. When you have removed the triangular piece from both ends of the waveguide, bend the upper and lower sections together to form a duck-bill tapered end. Move both upper and lower sections an equal amount.

In the dead center of the point of contact, a one-quarter-inch slot is cut into the front face of the vee that is now formed together. This slot has a width of about .064 inches ± .002 inches. The depth of the slot is .250 inches. Into this slot is placed a 1-inch-wide, .050-inch-thick piece of brass 1.250 inches long. The assembly is hard-soldered and all dimensions are checked for accuracy. All excess solder is removed from the inside of the guide as well as from the pieces—use as little solder as possible to make the cleanup job easier.

After you are satisfied that the parts have not shifted during soldering, you can drill the holes for the dipole and reflector in the .050-inch piece of brass. My elements were made from a .75-inch length of .125-inch brass stock obtained at a model train shop. I made the pieces longer than necessary to facilitate soldering and cleanup. In this way I only had to file them, after checking them with a caliper or micrometer to determine when

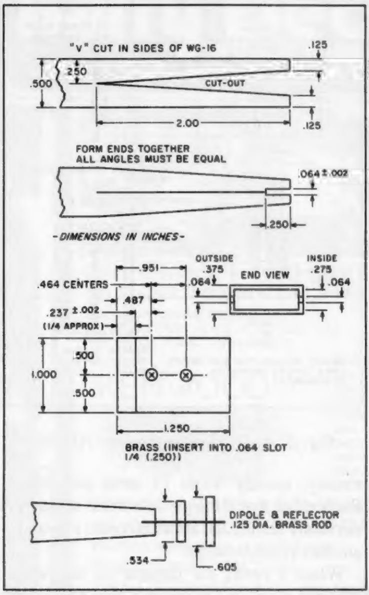

Fig. 1. Construction details for the 10-GHz dipole feed.

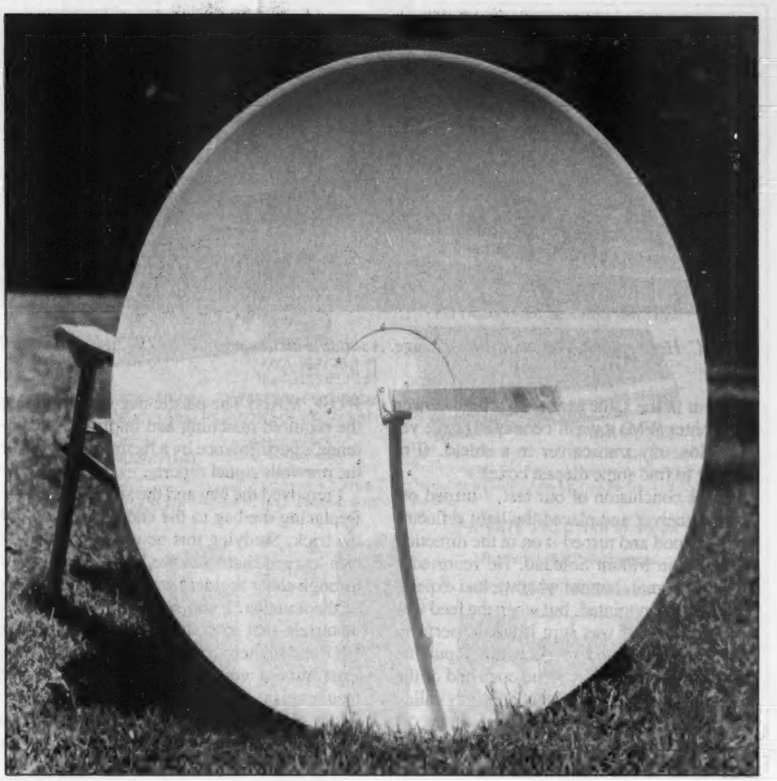

Photo B. 10-GHz dish antenna with dipole feed and dielectric resonator (plastic bag) in place.

they were cut to the proper length. Make checks often, as it is surprising how much material can be removed from this brass stock, and also check the spacing to the center stock to ensure that the elements are balanced in length.

Parabolic Dish Feed

I must have waited almost two years for other parts of the system to come into play before I was able to adapt the previous feed to a parabolic dish. I had been looking out for one for a long time without much success. I had even eyed the Sears Snowcoaster as a possible dish, but regarded the shape as too inefficient on close evaluation. Just not the right shape—close, but not right. I looked at many of the construction articles on dish antennas and thought about making one, but never did. I guess I was looking for the perfect inexpensive available dish antenna.

I finally found the perfect dish in one of the most unlikely places, but I came close to missing it completely. Only the intervention of a friend who was parked in a nearby truck prevented it. As I guided him out of a tight spot in a parking lot, I spotted the dishes. In the trash dumpster were two light reflectors, the type you see hanging from most high-school gyms for lighting the basketball court. The price made the acquisition even more desirable! They were 30 inches in diameter and had a large hole in their center. A small piece of metal could take care of that very easily. When I brought the two very dirty reflectors into work, some of my fellow hams thought I had lost some, if not all, of my marbles. Little did they know what madness was at work. After all, being a scrounger, one must be ever alert.

I was impressed by the curvature and the simplistic idea that if a reflector was made to do a good job with a light bulb, why not at lower frequencies, say 10 GHz? The depth of the curve from the outer edge to the center was 4.75 inches. With a diameter of 30 inches, the focus is equal to the diameter squared divided by 16 times the depth. In this case, the focus would be placed at approximately 11.8 inches. I took the dishes home and cut an 8.5-inch piece of round aluminum to cover the hole and soon was mounting the feed that I had made so long ago.

Dipole Feed Trials

I tested the dipole feed in my garage and in my backyard and the results were very encouraging. The antenna showed a very narrow beamwidth and quite a lot of improvement in gain over the 18-dB horn that I was comparing it to. Calculations showed that if all were operating well, I should expect about 35 dB of gain from this antenna system. I did not get a chance to add a matching screw network, as the gas tank used for the soldering operation was in need of a refill. See Fig. 2 for details on the screw tuner used to improve the match on waveguide 16.

Field Tests

My partner in this venture, Kerry Blank N6IZW, and I had tested the system performance with our transceivers located over short paths of about two to five miles, and we were eager to try a longer path. Kerry traveled to Mount Soledad on his lunch hour and I went to Mount Helix, as both these areas were within a short distance of our respective locations. The two locations are about 16 miles apart. While not record-setting distances, they did offer further field trials of our systems and provided a lot of enjoyment. Both of us set up similar systems using our off-center-feed dish antennas that were originally military 4-GHz antennas. (See Photo A for the off-center-feed antenna mounted with our original GUNN transceiver and small horn aimed at the reflector.)

We removed their feedhorns and replaced them with our homemade 10-GHz transceivers, and used a very small feedhorn to drive the dishes at each end of the path. We were able to make contact on 10 GHz, but I was experiencing very heavy FM broadcast interference on my end. Kerry and I were able to communicate with our systems and had approximately 25 microvolts of signal being received at each end of the path.

It was hard to keep the antennas aimed at each other due to the wind and the lightweight tripods we were using, but we kept in contact. The interference that I was having made the phase-locked detector circuit in the receiver search for a zero-discriminator reading, probably competing with or capturing the commercial FM station. When we were zeroed in, communication was crystal clear, but the slightest movement caused the FM signal to overtake us and destroy our contact.

The transceiver at that time was completely unshielded and open to rf pickup. The ground foil provided a very small measure of protec-

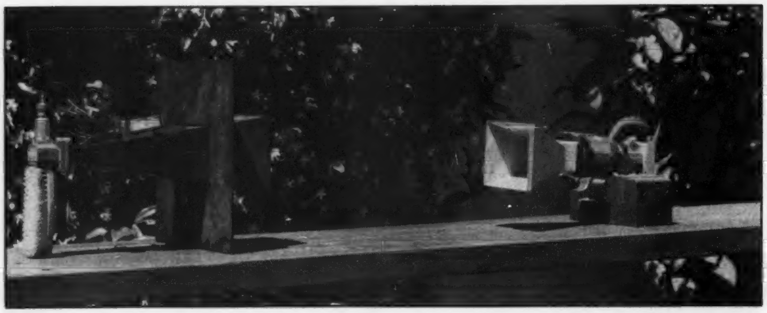

Photo C. Horn-antenna test adjustment range. A suitable distance would be 10–20 feet for small horns.

tion, but in the same area with a high-power transmitter (FM) it wasn't enough. I have yet to enclose my transceiver in a shield. (I'm waiting to find some diecast boxes.)

At the conclusion of our test, I turned off my transceiver and placed the light reflector on the tripod and turned it on in the direction of Kerry on Mount Soledad. He reported a copyable signal, but not what we had expected. I was disappointed, but when the feed was properly tuned I was sure it would perform quite well. I started to pack up. I put the traveling plastic bag over the open end of the feed and taped it into place when Kerry called me on two meters. I had forgotten to turn off my transmitter on 10 GHz, and I was now pegging the meter on his receiver. LIKE, *WOW*, MAN! The plastic bag was providing the required matching and improved the antenna's performance by a factor of 3 to 4 over the previous signal reports.

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I removed the bag and the signals dropped. Replacing the bag to the end of the feed did the trick. Studying this new phenomenon, it was learned that what we had accomplished through sheer accident was dielectric loading of the antenna. I was surprised to learn that materials that are very good insulators at VHF and higher turn into something else or at least have a very big effect at microwave frequencies. Enter the black-box theory. Photo B shows the dish and its plastic bag, our dielectric resonator. Fig. 2 shows how a plastic cover can be used to tune a slot antenna, a very good example of dielectric loading. I don't know what I would have done without the *RSGB VHF Handbook* as a reference on this and other topics.

Horn Antennas and Feeds

The horn is by itself a feed and also a very good radiating antenna. I am using a very small horn to feed the off-center-feed dish, as shown in the photographs. The horn used is part of the Solfan Intrusion Alarm device that was purchased at one of our local swap meets. The primary advantage in using a horn is its almost perfect match over a wide frequency range and its easy construction. This feed is also very impervious to errors in its construction. A horn is best described as a piece of waveguide with its end flared out, with somewhat the same ratio of width to length. As an example, a horn 6 inches in length with an opening of about 3.5 by 5 inches provides a gain of about 18 dB at 10 GHz. Photo C shows two horn antennas pointing at each other on an antenna test range. Although the distance is much too close as shown here, the operation of test evaluation is the same. The large horn has a detector mount and is coupled to a meter to measure relative signal strength received to tune up systems.

The most expensive part of construction of horns is the waveguide flange used to couple to the waveguide. I have usually purchased scrap pieces of waveguide built for some weird purpose, only to sweat the brased flange off and resue it on another project. Some real nondescript pieces of waveguide with custom bends can be had for very little money, usually about 75 cents per flange. Remember that if the guide is brass scrap, it is currently selling for about 60 cents a pound—another consideration.

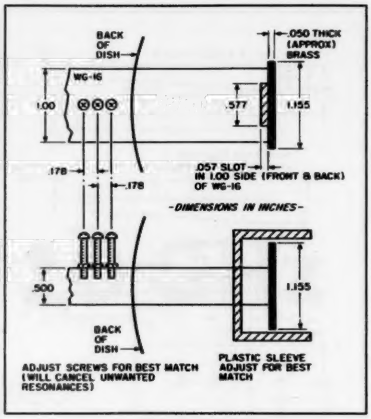
BACK OF DISH
.050 THICK (APPROX) BRASS
WG-16
1.00
.577
1.155
.178
.178
.057 SLOT IN 1.00 SIDE (FRONT & BACK) OF WG-16
-DIMENSIONS IN INCHES-
.500
1.155
BACK OF DISH
ADJUST SCREWS FOR BEST MATCH (WILL CANCEL UNWANTED RESONANCES)
PLASTIC SLEEVE ADJUST FOR BEST MATCH

Fig. 2. A slot-feed method for 10 GHz.

When I sweat the flanges off the waveguide, I place the guide in a vise and let the flange fall into a soft box of sand. Sometimes it is necessary to use gentle tapping to make the flange come off. Do not put the flange in a vise and pull off the waveguide, as you will distort the flange; I found out the hard way. You cannot fix a distorted flange, but you can sell it for 60 cents a pound.

Slot Feed

I have constructed a slot feed that is very easy to make—sort of a one-evening project. A hacksaw, files, and a small piece of brass are all that you need. See the design in Fig. 2 for details. This feed also uses the plastic feed-tuning (dielectric-loading) end-matching device. I have recently built this device, and preliminary testing indicates that its performance is quite good. One word on painting: Cover the slot so that paint does not get into the guide. I usually use a small wood block because it is easily removed after the paint is completely dry. I have found most enamels to be transparent at this frequency. Do not use any paint that has a fleck or a metallic part to its color. I have not tried them, but suspect they will offer some detriment to operation at 10 GHz.

I hope that I have given you some ideas on various feeds that can be made with ordinary hand tools. I do not feel that any special techniques are needed, just a little care in measuring and construction to keep the parts balanced. The construction of these feeds and antennas, when coupled with the transceivers that you have made, should provide many hours of enjoyment. I still delight in the operation on this band and hope that others will have as much fun on 10 GHz as I have.

I will make the 10-GHz GUNN diodes available to amateurs for $5 each postpaid in the continental U.S. These diodes provide an output of 50 to 100 mW; they are about .3 inches long and look like a 4/40 screw without a head. ■

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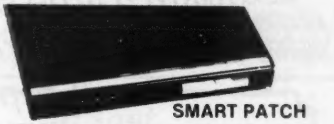

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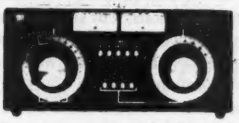

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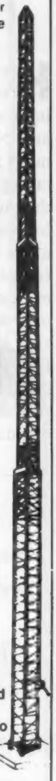

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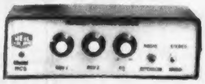

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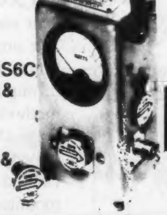

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How do I get a directional antenna installed in a community that has a building code prohibiting the installation of towers? No doubt this question has been asked many times by hams, but this was my first outing into the world of beam installation vs. the town fathers. The first answer that came to mind was to purchase a short "tripod" tower and mount it on the roof. There were a couple of drawbacks to this scheme, however. First, the town could well give me grief over this solution in that "a tower is a tower," and the tripod could be outlawed. Second, I have heard many horror stories about these mini-towers folding under wind pressure and damaging the roof of the house. This just did not seem to be the answer, and the obvious alternative, a chimney mount, didn't seem appropriate for a three-element triband antenna.

While discussing the problem with me on the local repeater, WA2GFO suggested that if I could somehow mount the antenna on the roof without using a tower at all, the objections of the town would be overcome and I'd have an operable antenna system. The solution was to mount the antenna rotator in the attic with a concentric length of plumber's "black pipe" going through the roof to the antenna. The added advantages of removing the rotator from the harmful effects of the weather and making it accessible from indoors for repairs and adjustment were bonuses—for which I was grateful when the rotator developed a problem when the weather outside was below zero. If the rotator had been mounted outside, it would have been out of service until the following spring. Since it was inside, it was a simple matter to effect repairs in comfort.

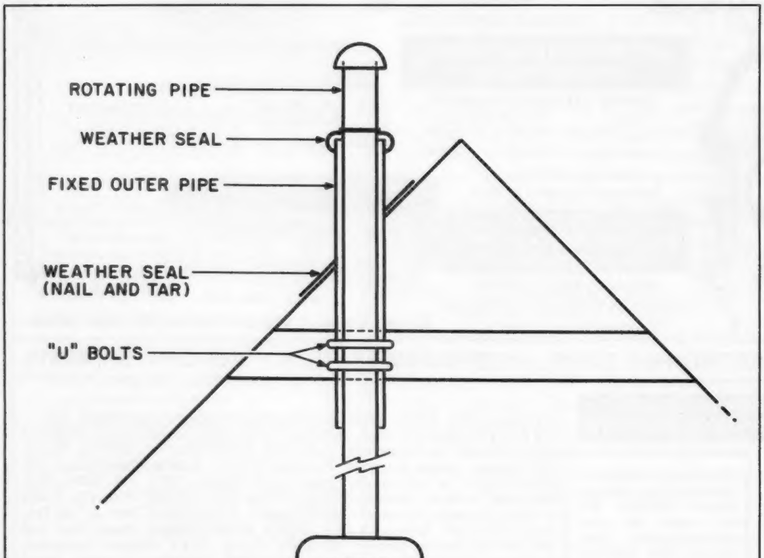

Fig. 1. WA2OLZ's through-the-roof mounting system protects your rotator from the elements and circumvents restrictive tower ordinances.

The basis of the installation is to provide a "pipe within a pipe." A hole of the appropriate diameter is cut in the roof by means of a hole saw on a hand drill. The outer pipe is fixed to the roof cross members from inside with U-bolts, and is permitted to extend outside the roof less than one foot. The inner pipe rotates freely within the outer pipe and is bolted to the rotator in the normal manner (see Fig. 1). The original plan called for a thorough application of heavy grease to the inner pipe so that it would rotate smoothly, but this was unnecessary as the pipes are sized such that there is no significant rotational drag.

I was most anxious to ensure that the installation was absolutely watertight—a new roof had been installed on the house the previous year and I had no desire to do that job again! The answer was really quite simple. Every house has a plumbing vent pipe poking through the roof. If I could duplicate the method used to seal this pipe to the elements, there should be no problem with leakage (I hoped). The local plumbing-supply house carried a device with a flexible rubber sleeve mounted to an aluminum plate for just this purpose. The sleeve is designed to provide a weather-tight seal around a vent pipe, and the aluminum plate is secured with roofing nails and roofing tar to the asphalt shingle roof. This was perfect for sealing the outer pipe, but the problem still remained of weatherproofing the small space between the inner and outer pipes.

It so happens that the rubber sleeves are available in various sizes to match the different sizes of "black pipe" commonly used as plumbing vents. So long as the inner and outer pipes are of adjacent sizes, the rubber boot that fits the outside diameter of the inner pipe will also match perfectly the inside diameter of the outer pipe. The top (exposed) end of the inner pipe was threaded by the plumbing supply house and sealed with a cap designed for this purpose. An additional short length of pipe could optionally be added at this point via a plumbing coupling should it be desired to stack a smaller (2-meter) beam above the primary antenna. This has provided an absolutely weather-tight seal at WA2OLZ through heavy downpours, high wind, and significant snow accumulation.

The very able assistance of N2ESX resulted in the installation of the antenna in only one afternoon. This is definitely not a one-person job! Be certain to observe proper safety techniques and have a safety man in attendance whenever working on the roof.

The antenna is mounted only three feet above the roof in this installation but has generated excellent results including an S9 +20 report from a USSR station in a heavy pileup the first time it was put into service. No doubt even better results could be obtained by using a longer length of inner pipe in order to raise the antenna to a better altitude. I was reluctant to do so, however, for fear of generating excessive side loads on the outer pipe and resultant binding and possible damage to the rotator.

This installation has exceeded my expectations at WA2OLZ and did not incur the wrath of the township powers. In fact, the low height above the roof makes the antenna almost invisible from the street unless you are looking for it. ■

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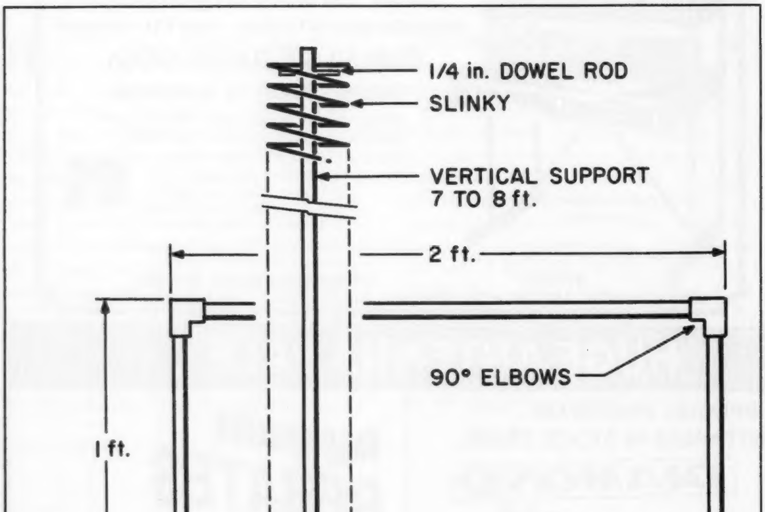

Fig. 1. The Springy portable antenna.

How would you like to have a portable antenna that works like a charm on all the HF ham bands, weighs only a couple of pounds, can be erected anywhere in a matter of minutes, and costs less than $10? Impossible, you say? Well, read on, because the antenna I am about to describe is all that and more.

My job requires lots of travel and I like to operate HF. This can be very challenging and frustrating at the same time. Every new motel room requires a different setup, with much time wasted trying to adjust different lengths of wire with the tuner to find a combination that gives the lowest swr. I enjoy operating QRP CW with an Argonaut and a Century 22, so antenna efficiency is very important. I have tried every type and combination of indoor antenna imaginable over the years, and have found that this little gem works better than most. Best of all, it gives constant loading combinations to my tuner so that I don't have to waste time trying to retune every time I set up.

As you can see, this wonder antenna, the Springy, is built around a toy Slinky™ and two 10-foot lengths of 3/4-inch PVC plastic pipe. You also will need four 90-degree elbows, three T-connectors, and two straight connectors for the 3/4-inch pipe, plus two pieces of 1/4-inch dowel rod four inches long.

Begin construction of the antenna base by cutting one of the 10-foot pipes into two 2-foot and six 1-foot lengths. Construct the base as illustrated in Fig. 1. You do not need to glue any of these joints as they fit very tightly—and once glued, they cannot be taken apart.

Cut the second 10-foot pipe into two 3-foot, one 2-foot, and two 1-foot lengths. Use a combination of these sections to construct the vertical element of the antenna stand. The different lengths of pipe will allow you to vary the height of the vertical element to fit the ceiling height of different rooms.

Drill a 1/4-inch hole through the vertical element at each end. These holes will be used to hold the wooden dowels that support the

Slinky and keep it stretched out. As you can see from the illustration, the Slinky is placed over the vertical pipe and just hangs down.

A tuner will be required to load the Springy. I built mine out of old broadcast variable capacitors and some coil stock I had in my junk box. Any of the smaller commercial tuners will work, but for portable operation, the smaller the better.

With my tuner I am able to load the Springy, with a flat swr, on all bands. I use a small length of wire with an alligator clip at one end to clip onto the bottom of the Slinky. The tuner sits at the base and is connected to the rig via a small length of coax.

I have found the settings on the tuner to be almost the same every time I set the antenna up. There will be slight differences caused by different surroundings, but some minor adjustments are all it takes to get a flat swr. The Springy seems to be broadbanded, and very little adjustment is needed when changing frequencies inside a band.

I made a small case from 1/4-inch plywood to carry the plastic stand, Slinky, tuner, and lengths of coax. The first thing I do when arriving at a new location is to set the antenna up, connect the Argonaut or the Century 22, and get on the air. I keep the tuner-setting combinations on a small file card in the box with the antenna. Many times I don't have to do any touch-up at all to get a perfectly flat swr. One point to watch when adjusting for the best swr: Wait until the Slinky has stopped bouncing after you hang it from the vertical stand. The bouncing changes the inductance as the distance between the coils of wires changes, and trying to get a good reading is very difficult, to say the least!

If you are looking for a great little portable antenna to use while on vacation or any time you hit the road, the Springy will do the trick. My first QSO with it was from my kitchen, with a W5 in Texas, on 40 meters. As he gave me an RST of 589—and I was running only about 20 Watts with the Century 22—I knew I had a winner.

> ***"It fits in your pocket, is inexpensive, and if the band goes dead, you can always play with the thing."***

I usually carry a small roll of wire with an alligator clip on one end to ground the tuner to the cold-water pipes in the hotel room. This seems to help my signal get out and at the same time makes the Springy more broadbanded.

If you are the adventurous type who likes to operate portable outdoors, give the Springy a try by hanging it from a tree limb with a rope. I've found it works very well suspended about 10 feet above the ground. Drive a stake into the ground directly under the antenna and tie a piece of string or other nonconducting material to it to keep the Slinky taut. Load it from the bottom as you would any vertical.

The little Springy antenna works great outdoors or in, so give it a try the next time you need a portable, allband antenna. It fits in your pocket, is inexpensive, and if the band goes dead, you can always play with the thing.

I should include one word of caution concerning the use of this antenna. Its use does tend to attract attention, especially when hung from a tree in public camping areas. If being stared at and having your sanity questioned by everyone in camp bothers you, don't use this antenna. If having people suddenly grab their children by the arm when within 50 yards of you and moving them to the other side of the park disturbs you, don't use this antenna. But—if you want to have fun on the air from just about any location, give the Springy a try. After all, most people thought Marconi, Edison, and the Wright brothers were a little strange, too, so you are in good company! ■

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The Texas Tango Antenna

Ticked off at traps, K5BTV stumbles onto a 75/40m tuned-stub dipole.

Over the years I've tried many types of antennas for 75 and 40 meters. These have included verticals, folded dipoles, inverted vees, and trapped antennas—plus a few that still defy description. Several common requirements have emerged through this work: The antenna has to be confined within my property line (90 feet x 120 feet) and the wires kept to a minimum to keep the neighbors and XYL at bay. But most importantly, the antenna has to perform well.

The addition of the WARC bands presented a new challenge. Until I could develop a suitable yagi to cover the bands above 40 meters, a trapped inverted vee seemed the best way to become active on the new bands. So a three-band trapped inverted vee was constructed to cover 75, 40, and 30 meters using coaxial-cable coils on PVC tubing.

The trapped inverted vee was erected at 40 feet on my tower. On 75 meters, the operating frequency limit to stay within a 2:1 swr was approximately 50 kHz; on 40 and 30 meters it was about 25 kHz. The coil-and-capacitor trap impedance is responsible for the bandwidth of each band, as described in an article by John Grebenkemper (*QST*, May, 1985). But having already constructed the antenna, I knew I would have to construct new traps if I desired more bandwidth.

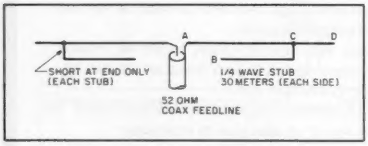
A
B
C
D
SHORT AT END ONLY (EACH STUB)
1/4 WAVE STUB 30METERS (EACH SIDE)
52 OHM COAX FEEDLINE

Fig. 1. Quarter-wave stub traps on a half-wave dipole. For a 75/30-meter antenna, the distance from A to D = 234/3.825 = 61 feet. The distance from A to B = B to C = 234/10.115 = 23 feet.

While enjoying the patio and thinking about the disadvantages of the coaxial traps (moisture penetration, arcing of the capacitor, added weight, etc.), I thought about an old TVI-prevention scheme that used a tuned stub to trap out the offending signal. Then the idea came to light. Since a quarter-wave section of feedline that has been shorted at one end and is open at the other exhibits an infinite impedance at the open end—perfect for a trap—why not use quarter-wave stubs for traps? Some further thought provided the final solution: Make the 75-meter leg of an inverted vee part of a quarter-wave stub for 30-meter operation.

Fig 1. shows the mechanical layout. At my station, I use separate 40- and 75-meter antennas fed from a single 52-Ohm coax feedline. The 40-meter antenna is broadside to the north, allowing me to keep schedules with my dad (W0IMZ) while the 75-meter inverted vee is used for contacts east and west of my QTH. The object was to end up with two antennas that could operate on 75, 40, 30, and 12 meters using one 52-Ohm feedline.

Construction of the antenna was surprisingly simple, as was the adjustment. First the 75- and 40-meter inverted-vee antenna elements were erected using #14 copper wire obtained from the local hardware store. The antennas were then resonated at the frequency of interest on each band. The 75-meter antenna was to carry the 30-meter stub, and the 40-meter antenna the 12-meter quarter-wave stub. Since the construction of both antennas uses the same principles, this discussion will cover 75/30-meter elements.

From the feedpoint on the 75-meter leg, measure out a quarter wave using the *Radio Amateur Handbook* equation L(feet) = 234/f (MHz). For 30 meters this is L = 234/10.115, or 23.1 feet. Therefore, from the feedpoint, measure out 23.1 feet. This is the point at which the open end of the 30-meter stub begins. You may want to wrap a piece of masking tape on the 75-meter leg to mark the spot for future reference. From this spot, lay out the 23.1-foot wire beneath the top wire. At the end of the quarter-wave stub, it will be necessary to short the wire to the top 75-meter section. I used alligator clips so I could tune the stub before I soldered the connection. To complete the stub, you must use spacers for the wires. Radio Shack has

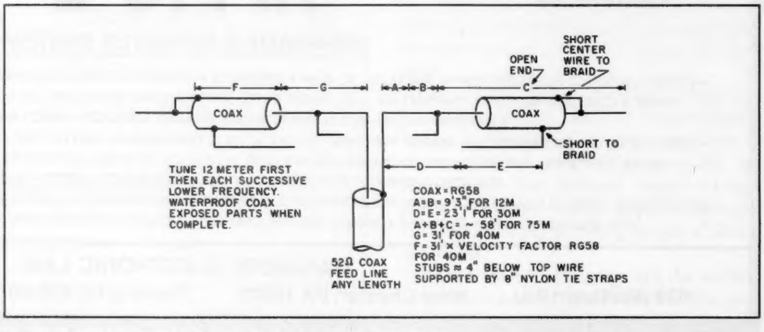
F
G
A
B
C
D
E
COAX
COAX
OPEN END
SHORT CENTER WIRE TO BRAID
SHORT TO BRAID
TUNE 12 METER FIRST THEN EACH SUCCESSIVE LOWER FREQUENCY. WATERPROOF COAX EXPOSED PARTS WHEN COMPLETE.
52Ω COAX FEED LINE ANY LENGTH
COAX = RG58
A=B= 9'3" FOR 12M
D=E= 23'1" FOR 30M
A+B+C= ~ 58' FOR 75M
G= 31' FOR 40M
F= 31' × VELOCITY FACTOR RG58 FOR 40M
STUBS ≈ 4" BELOW TOP WIRE SUPPORTED BY 8" NYLON TIE STRAPS

Fig. 2. Single-wire antenna for 75, 40, 30, and 12 meters (untried, but it should work).

6-inch nylon cable ties that work well for spacers. Simply loop them around the two wires and pull the tie to the first notch, locking it. This results in approximately a 3-inch spacing. The wire size and spacing result in approximately a 600-Ohm quarter-wave stub. Wooden dowel spacers could also be used.

An alternative to the construction as discussed above would be to use 300-Ohm twinlead or commercial open-wire twinlead. Simply use one leg as the top element of the 75-meter antenna. An advantage of twinlead is that it can be cut to approximately one-quarter wavelength, shorted at one end, and resonated using a grid-dip meter while on the ground. Then one side of the wire can be used as the top-wire element for the 75-meter antenna.

Once the mechanical details have been worked out, final-tune the 30-meter stub—either by moving the alligator clip toward the feedpoint an inch or two at a time if the resonant frequency is too low, or by moving the shorting alligator clip to the far end if the resonant frequency is too high. A final check of the 75-meter band will now be necessary because of the effects of the lower wire. Once the antenna is resonated, you may want to solder the end of the stubs to the top section to complete the job. You are now ready for some fun operating.

> ***"I thought about an old TVI-prevention scheme that used a tuned stub to trap out the offending signal."***

Operation of this antenna has met the expectations set for it. Tuning the 75-meter band from the low-frequency point to the high-frequency point provided a vswr of 2:1 or better over 4.4% of the band, which was almost the same when the 75-meter inverted vee was used alone. The 30-meter operation covered the entire 30-meter band with less than a 2:1 vswr. It measured about 2.2% of the resonant frequency. These percentages seem to agree with the expectations derived from the *QST* article.

This antenna offers some advantages over coil/capacitor trapped antennas. It eliminates the need for high-voltage capacitors. It also can handle the full, legal power limit, is easy to construct, and provides wide bandwidths on each band. There are several other methods that should prove satisfactory whereby quarter-wave traps could be constructed. Although I've not tried it, a single, full-size wire antenna could be made for 75, 40, 30, and 12 meters using a combination of coax quarter-wave stubs and open-wire quarter-wave stubs (see Fig. 2). I would like to hear from others who may try these ideas. 73 and good operating over more of our bands. ■

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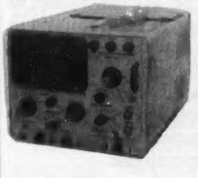

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Trap An Amazon Aerial

Build your own capacitors and trap-tune your dipole for multiband operation.

A trap-tuned dipole can make a very satisfactory multiband antenna, but building it can be a real headache! My first attempt to build a trapped antenna, in 1970, resulted in dismal failure (which explains my formerly held low opinion of them). I must have learned something since then, for I now have several trap-tuned dipole antennas giving excellent service in a commercial radio communications net that I help maintain.

Perhaps among the readers of this magazine there is someone else who has been frustrated in an attempt to use traps in an antenna. If so, you may benefit from a discussion of the design procedure I followed.

I needed several antennas for use with 20-Watt transceivers operating on 6.954 MHz and 5.710 MHz. These made up portable stations carried by research teams working in the Amazon jungle. Our licenses limited us to dipole antennas, but for portability I didn't want to send two antennas with each station. In addition, since the antennas would be carried as baggage and would be erected by untrained personnel, I didn't want them to be either heavy or complicated. What resulted was a relatively lightweight, rugged dipole antenna that gives less than a 2:1 vswr at both frequencies.

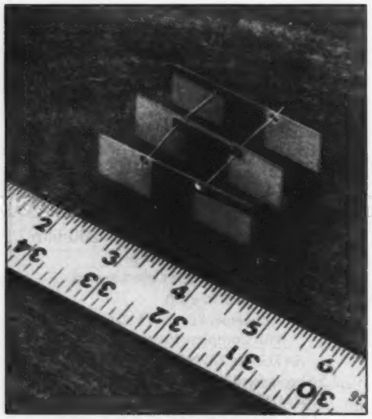


Photo A. Capacitor assembly strung on jumper wires; ready to be glued together.

The Trap-Tuned Dipole

A trap-tuned dipole for two frequencies is shown in Fig. 1. The inner antenna is cut for the higher operating frequency. Traps that are parallel-resonant at the higher operating frequency separate the inner antenna from extensions. The high impedance shown by the traps isolates the inner antenna from the extensions when the higher frequency is being used. Below resonance, the traps appear to be inductors connecting the extensions so that the overall antenna is active at the lower operating frequency.

Inductors and capacitors are reactive elements. That is, they react to alternating current to show a frequency-dependent opposition to current flow. The Ohmic values of inductive and capacitive reactances are calculated using Equations 1 and 2, respectively. These reactances are, you might say, of opposite characteristics, though both are measured in Ohms.

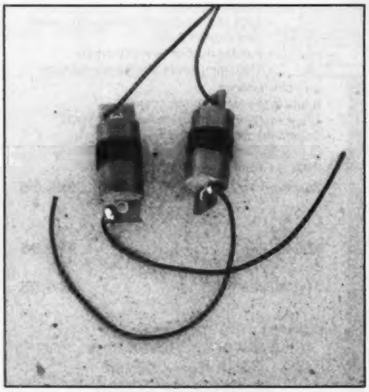


Photo B. Completed traps.

For a complete treatment of these reactances, phasor algebra is employed. I won't go into that. Suffice it to say that strange things happen in circuits containing both inductive and capacitive reactances.

Equation 1: $X_L = 2\pi fL$

Equation 2: $X_C = 1/(2\pi fC)$

where L is the inductance in Henrys, C is the capacitance in Farads, f is the frequency of operation in Hz, and X_L and X_C are in Ohms.

As you can see from these equations, inductive reactance increases and capacitive reactance decreases as frequency increases. A circuit containing an inductor and a capacitor will have both inductive reactance and capacitive reactance. At some frequency, those reactances are equal and cancel, resulting in the phenomenon called "resonance." When the reactances are in series, this cancellation results in a low impedance. When the reactances are in parallel, the result is a very high impedance, which is the characteristic that makes a trap-tuned antenna possible.

Equation 3, giving the relationship between L, C, and resonant frequency, shows that virtually any inductor can be made to resonate at any frequency by selecting the proper capacitor.

Equation 3: $f_r = 1/(2\pi\sqrt{LC})$

where L is inductance in Henrys, C is capacitance in Farads, and f_r is the resonant frequency in Hz.

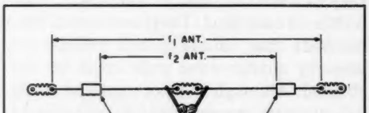

f_1 ANT.
f_2 ANT.
TRAP
TRAP
f_1 = LOWER OPERATING FREQUENCY
f_2 = HIGHER OPERATING FREQUENCY

Fig. 1. Trap-tuned dipole antenna.

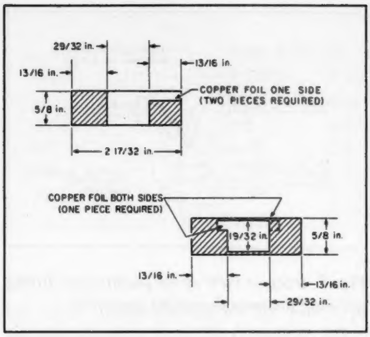

29/32 in.
13/16 in.
13/16 in.
5/8 in.
COPPER FOIL ONE SIDE (TWO PIECES REQUIRED)
2 17/32 in.
COPPER FOIL BOTH SIDES (ONE PIECE REQUIRED)
19/32 in.
5/8 in.
13/16 in.
13/16 in.
29/32 in.

Fig. 2. Plates for 50-pF capacitor assembly.

F (MHz)	C (pF)	L (uH)	L/C
6.954	50	10.5	210,000
7.200	47	10.4	221,277
14.300	24	5.16	215,000
21.300	16	3.5	218,750
28.200	12	2.65	220,833

Table 1.

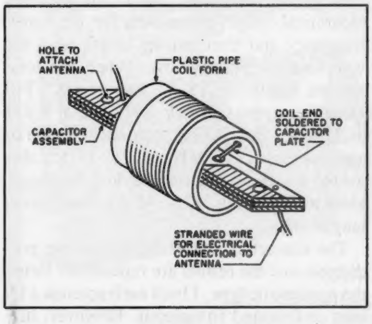
This indicates that traps can be built using a wide range of values, but there are some practical considerations. The relationship of L and C to the resonant impedance of the trap is shown in Equation 4.

Equation 4: $Z_t = L/(CR)$

where L is inductance in Henrys, C is capacitance in Farads, R is the resistance of the inductor in Ohms, and Z_t is the resonant impedance in Ohms.

As L is increased and C is decreased, Z_t increases. A high L/C ratio would seem to be best in order to ensure that the trap will show a high impedance at resonance. However, the physical size of a large-value inductor imposes some limitation, as does the difficulty of using extremely small values of capacitance. It is necessary to strike a compromise.

At the frequency I used, 6.954 MHz, I found that a 10-uH inductor and a 50-pF capacitor give good results. Their impedances are about 460 Ohms and their L/C ratio is around 200,000. From Equation 4 we find that the parallel-resonant impedance of these components will be over 200k, even if the dc resistance of the inductor is as high as 1 Ohm. It is reasonable to expect less than 1 Ohm of resistance in the coil, so these were the component values I selected.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CAPACITOR ASSEMBLY
COIL END SOLDERED TO CAPACITOR PLATE
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Fig. 4. Trap assembly.

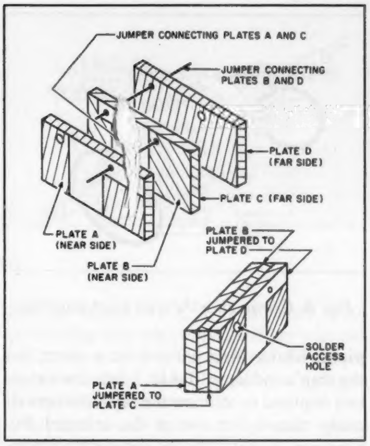

JUMPER CONNECTING PLATES A AND C
JUMPER CONNECTING PLATES B AND D
PLATE D (FAR SIDE)
PLATE C (FAR SIDE)
PLATE A (NEAR SIDE)
PLATE B (NEAR SIDE)
PLATE B JUMPERED TO PLATE D
SOLDER ACCESS HOLE
PLATE A JUMPERED TO PLATE C

Fig. 3. Capacitor assembly detail.

I calculated the capacitances required at various frequencies for an impedance approximately equal to the impedance presented by the 50-pF capacitor at 6.954 MHz. I then used Equation 5 to calculate the inductances required to resonate the capacitors at those frequencies, and verified that the L/C ratio was at least 200,000.

Equation 5: $L = 1/(4\pi^2 f^2 C)$

where f is the desired resonant frequency in Hz, C is the capacitance in Farads, and L is the inductance in Henrys.

Table 1 gives the component values used and shows the L/C ratios.

The Capacitors

I decided to deal first with the capacitors, since inductors are relatively easy to adjust to a desired value. I experimented with both molded mica and dipped silver-mica capacitors. (Admittedly, this was possible only because I was working with low power. For higher power, special transmitting capacitors are needed.) The silver-mica type produced good results, but I didn't have enough of them to make all the antennas I needed. Being somewhat reluctant to spend money needlessly, I decided to try building my own capacitors. Why buy when you can build?

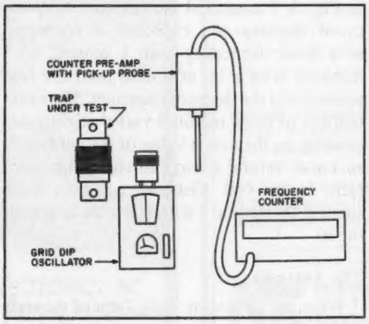

COUNTER PRE-AMP WITH PICK-UP PROBE
TRAP UNDER TEST
FREQUENCY COUNTER
GRID DIP OSCILLATOR

Fig. 5. Test setup.

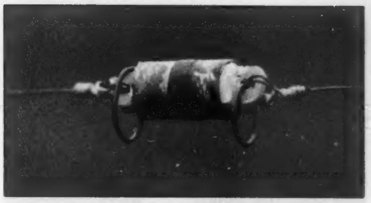


Photo C. Trap installed in antenna.

Double-clad, glass-epoxy printed-circuit-board stock seemed a good choice of material since I had some on hand, but before becoming too deeply committed to this project I wanted to determine the feasibility of using this material for these capacitors. I didn't want to build a capacitor that would make the traps so large that the antenna would not fit the shipping container!

Capacitance is relatively easy to relate to size, but the equations invariably call for the dielectric constant. Since this figure was not available to me, I determined it by measuring the capacitance of one square inch of the board material and comparing it with the calculated capacitance of an air-dielectric capacitor of the same dimensions. (I used a capacitance meter built following plans in an amateur magazine, so this isn't really an exotic piece of equipment.)

The measured capacitance was 30 pF/square inch. The capacitance with air dielectric was calculated to be about 5.1 pF, using Equation 6.

Equation 6: $C = 0.2249 \times (kA/d) \times (n - 1)$

where C is capacitance in pF, A is the area of one plate in square inches, d is the distance

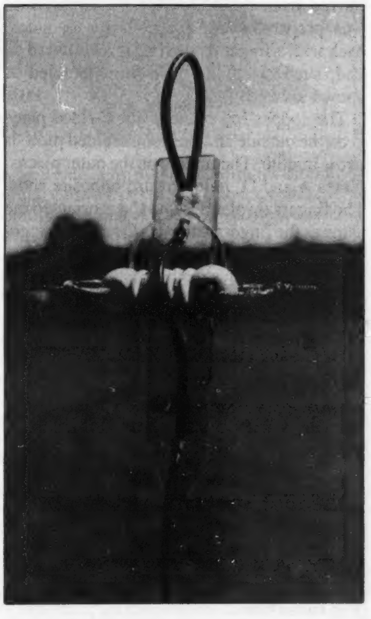


Photo D. Feedline protection using the PY8ZAC/W8VOH method.

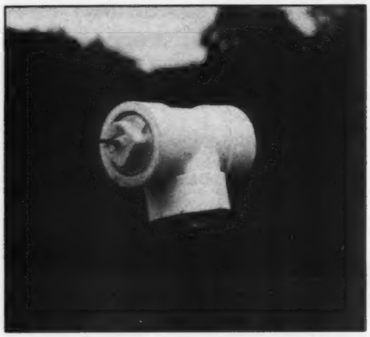


Photo E. Feedline protection using plastic pipe fitting.

separating the plates in inches, n is the number of plates in the capacitor, and k is the dielectric constant of the insulating material (30 pF/5.1 pF = 5.9).

Using Equation 6, with $k = 5.9$, I found that the required plate area for a two-plate, 50-pF capacitor is approximately 1.6 square inches. That was a bit larger than I wanted. One more pass through the equation showed that a 4-plate, 50-pF capacitor required a plate area of only 0.56 square inches, which seemed much more reasonable for my application. The calculated dimensions and number of plates for the capacitors are shown in Table 2.

I built the 50-pF capacitors using plates measuring 5/8″ x 29/32″, prepared by cutting the copper foil on three pieces of board material as shown in Fig. 2. The copper on one side of two of those pieces was cut so as to center the plate area and leave a finger extending to one end of the piece, while the copper was removed from the other side. A single piece was prepared with a plate on both sides, each with a finger extending 3/16″ toward an end, such that they could be assembled as shown in Fig. 3.

The copper foil of each single-sided piece is on the outside and the double-sided piece is in the middle. The fingers on the outer pieces, plates A and D, point toward opposite ends. The fingers on plates B and C are oriented the same as the fingers on plates D and A, respectively. I used epoxy to glue all the pieces together.

Access holes drilled for this purpose allowed jumpers to be soldered to connect the fingers on the inner piece with the corresponding fingers of the outer plates to form a 4-plate capacitor. I then trimmed the capacitor to measure precisely 50 pF by cutting thin strips of copper from the exposed plates. The glass-epoxy board pieces are long enough to extend beyond the area used for the capacitor so that they can be used to attach the antenna. The same procedure was used for the other capacitors, using the dimensions given in Table 2.

The Inductors

As shown in Fig. 4, I glued each rectangular capacitor into a piece of 5/8″ plastic pipe, which also served as a form for the trap's inductor. Table 3 lists the inductors required to resonate the capacitors previously chosen for use at the selected frequencies. To calculate the approximate number of turns of wire required for each, I divided the inductance per inch of the proposed coil into the desired inductance and multiplied the quotient by the turns per inch. The inductance per inch may be found from Equation 7.

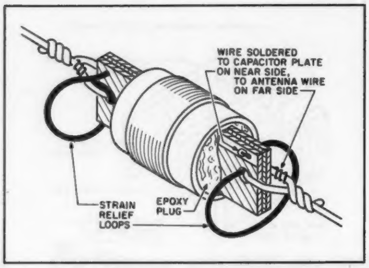

WIRE SOLDERED TO CAPACITOR PLATE ON NEAR SIDE, TO ANTENNA WIRE ON FAR SIDE
STRAIN RELIEF LOOPS
EPOXY PLUG

Fig. 6. Connecting the trap to an antenna.

$$\text{Equation 7: } L = (nr)^2/(9r + 10l)$$

where L is inductance in uH, l is the length of the coil in inches, r is the mean radius of the coil in inches, and n is the number of turns in the coil.

For my low-power use, I felt safe using a close-wound coil, so n was based on the turns-per-inch specification from the wire tables. From Equation 7, I found that #26 wire close-wound (58 turns per inch), 1 inch long on a 13/16″ form (the outside diameter of 5/8″ plastic pipe) will have approximately 39 uH of inductance. Dividing the desired inductance, 10.5 uH, by 30 uH and multiplying by 58 turns per inch indicated that 16 turns would be required (see Table 3).

I then checked my figures by calculating the inductance of 16 turns of #26 wire close-wound on a 13/16″ form and found it was only 6.5 uH! Apparently the relationship is not linear. By this kind of repetitive calculation, I determined that 22 turns will produce approximately 10.5 uH.

With the capacitor assembly glued in place inside the coil form, I wound the calculated turns of wire plus about 10% onto the plastic pipe and soldered the ends to the capacitor. Using the test setup shown in Fig. 5, I measured the resonant frequency of the trap. As expected, it resonated at a lower frequency than I wanted, so I removed wire a bit at a time until the trap resonated at the desired frequency. The exact number of turns required varied slightly depending on the actual value of the capacitor, so I was careful always to start with extra turns in the coil. Generally, I have more success shortening a wire than I do lengthening it!

The Antenna

When the traps were built, I sealed the ends of the coil forms using epoxy putty and coated the entire assembly with regular epoxy to secure and protect the coil. Wires soldered to the fingers of copper foil on the capacitor pieces are used to connect the traps to the antenna.

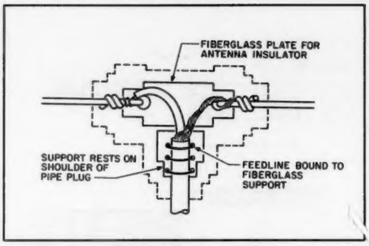

FIBERGLASS PLATE FOR ANTENNA INSULATOR
SUPPORT RESTS ON SHOULDER OF PIPE PLUG
FEEDLINE BOUND TO FIBERGLASS SUPPORT

Fig. 7. Interior view of the plastic pipe fitting showing antenna feedpoint assembly.

The antenna was built following the pattern of Fig. 1. The inner antenna was cut for the higher frequency, f2, according to the length calculated using Equation 8.

$$\text{Equation 8: } l = 468/f$$

where l is the antenna length in feet and f is the operating frequency in MHz.

For 6.954 MHz, the inner antenna was 67′ 4″ long. At that frequency, the traps are intended to serve as insulators. Returning to Equation 4, we can calculate the theoretical impedance of these traps at resonance to get an idea of their effectiveness for this purpose.

The 10-uH inductor required 4.25 feet of #26 wire, which has about a 0.04-Ohm resistance per foot, so R will be 4.25 x 0.04 Ohms, or 0.17 Ohms.

Applying Equation 4, we find:

$$\begin{aligned} Z_t &= L/(CR) \\ &= 10.5 \times 10^{-6}/(50 \times 10^{-12} \times 0.17) \\ &= 1.24 \times 10^{6} \text{ Ohms} \end{aligned}$$

That is 1.24 megohms, which should isolate the inner antenna adequately at the higher frequency. This impedance could be increased by using larger wire for the inductor so as to have a lower value of resistance in the coil.

At 5.710 MHz, the traps exhibit 560 Ohms of capacitive reactance and only 370 Ohms of inductive reactance, so the antenna current will flow mostly through the inductor. This inductance will tend to electrically lengthen the antenna, so its physical length will be somewhat shorter than its theoretical length. It probably would be possible to calculate this, but I just used the theoretical length of antenna for the lower frequency and trimmed the length until the vswr was acceptably low. When the total antenna length was 75′ 5″, the vswr at 5.710 MHz was approximately 1.8:1 and at 6.954 MHz was 1.5:1. As the theoretical length of antenna for 5.710 MHz is 81′ 11.5″, this means the traps reduced the low-frequency antenna to about 92% of its theoretical length.

The characteristics of these traps are predictable and the results are repeatable. Being the pessimistic type, I built each antenna a bit long at first and trimmed it. However, as I gained confidence, I began cutting them to

C (pF)	Plate Area (sq. in.) 2-plate	Plate Area (sq. in.) 4-plate	Capacitor Used (see text)
50	1.6	0.56	4 plates, 5/8" x 29/32"
47	1.5	0.52	4 plates, 5/8" x 27/32"
24	0.78	0.27	4 plates, 1/2" x 9/16"
16	0.52	0.18	2 plates, 5/8" x 27/32"
12	0.39	0.13	2 plates, 9/16" x 23/32"

Table 2.

L (uH)	Coil on 3/16" Form
10.5	22 turns #26, close-wound
10.4	21-3/4 turns #26, close-wound
5.16	13-3/4 turns #26, close-wound
3.5	11 turns #26, close-wound
2.65	9-1/4 turns #26, close-wound

Table 3.

the same measurements as the prototype without allowing extra for trimming. All of these measured less than a 2:1 vswr at both operating frequencies.

Ensuring Durability

Since these traps were used as the mechanical support of the antenna, I was concerned that they might not be strong enough to withstand the pull. As a crude test, I tied one about 10 feet up on an antenna tower and stood in a loop of wire attached to it. It supported my weight (190 lbs.), so I concluded that the antenna wire would break before the traps would.

One weak point in this antenna is the connection of the traps to the antenna wires. Since the antenna sways in the wind and is taken down periodically, the trap connections are subject to flexing. I have had good success in reducing the effects of that flexing by making the connections using a strain-relief loop, as shown in Fig. 6. In the event that a connecting wire does break, another wire can easily be soldered to the finger of the capacitor plate without disturbing the epoxy plug in the end of the coil form.

Another weak point on any wire dipole antenna is the fact that the feedline is open at the top. If water enters the feedline, it will cause the line to deteriorate, and may even run out at the bottom end making a puddle where you least expect it!

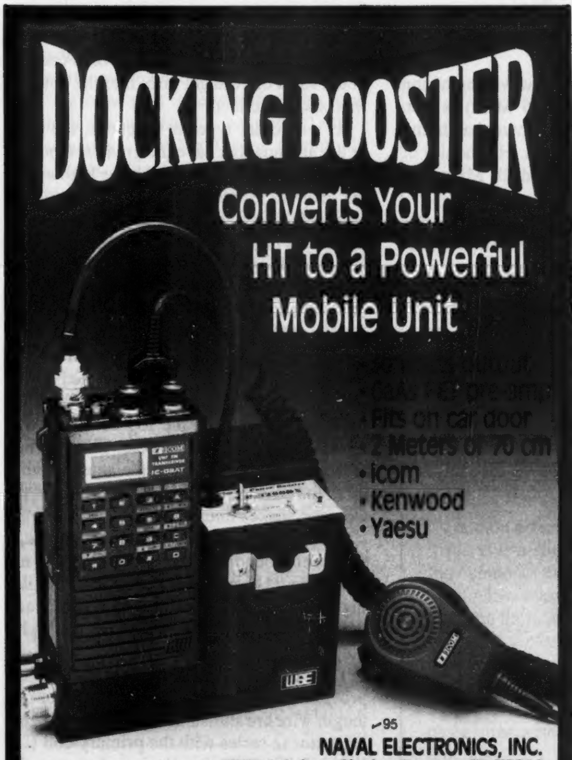
Photo D shows one solution to this problem—as described in *73* almost 10 years ago by PY8ZAC/W8VOH. The loop in the coaxial cable keeps the open end pointing down so rain will drain away from it. Sealing the open end with epoxy or a *noncorrosive* silicone rubber will provide additional protection. (Note that the silicone rubber preparations that smell like vinegar will cause corrosion.)

Photo E shows a more elegant way to weatherproof the center feedpoint. A plastic pipe T connector encloses the antenna feedpoint assembly (Fig. 7). The holes in the three pipe plugs, through which the wires and feedline pass, are sealed by means of epoxy or noncorrosive silicone rubber.

Conclusion

I have found the performance of these antennas to equal that of regular dipoles while occupying less space and weighing less. In addition, they cost less. The epoxy seal has held up well even with the rains we experience in the tropics. The only antenna I have had to repair, of the ten I have in use, is the one that broke when a strong wind caused the supporting tree to sway more than we expected. The antenna wire broke, rather than the trap, so this confirmed the results of my crude weight-bearing test.

It's a pity I "grow too late smart"! These antennas could have saved me lots of work over these past years! ■



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Resonant Wire Antennas

You may not believe it, but you can *build a working antenna without the crutch of coax!*

More often than not, homemade antennas perform better than store-bought ones. This is because most commercially-manufactured systems are designed primarily so that they can be fed with coaxial cable. Performance is only a secondary consideration.

Coaxial cable is neat stuff and is convenient to use. But, it's expensive, and, although a few amateurs think that *all* antennas are fed with coaxial cable, it's the worst kind of feedline to use if the antenna is to work effectively on several amateur bands.

How would you like to have an antenna that works well on several bands and one that has *no* feedline loss? Impossible, you say? Not at all. You can build an antenna that has no feedline, and therefore no feedline losses. Simply use the following principles in your design:

1. A half-wave resonant antenna (dipole) has high rf *voltage* at its ends and high rf *current* at its center (see Fig. 1).
2. The length in feet of a half-wave resonant antenna is 468 divided by the frequency in megahertz (L = 468/f).
3. An antenna that is a half wavelength long for a low band (such as 3.5 MHz) is also resonant at harmonics of the lower bands and has high rf voltage at its ends. Harmonics of 3.5 MHz are 7, 14, 21, and 28 MHz (see "Harmonics" sidebar).
4. In tuning a coil and capacitor to resonance at a given frequency, parallel tuning is used to provide *rf voltage*, which is needed to feed the end of a resonant-length antenna.
5. Link coupling can be used to take rf from the transmitter into a parallel-tuned inductor, one end of which is connected to the end of a resonant-length antenna. The other end of the parallel-tuned coil is connected to the grounding system (see Fig. 2). The rf energy, in the form of voltage, goes into the antenna wire and is radiated.

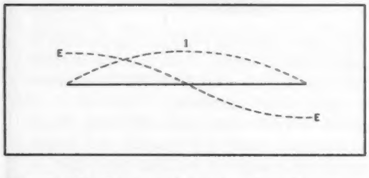

Fig. 1. Rf voltage and current distribution on a half-wave resonant antenna.

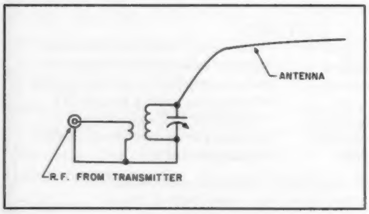

Fig. 2. Feeding rf voltage *to the end of a resonant antenna (parallel-tuned coil to give rf voltage).*

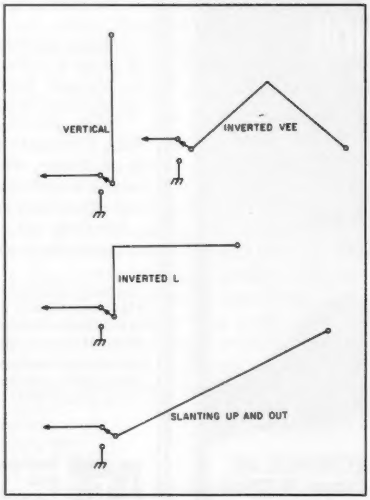

Fig. 3. Some endfed-antenna configurations.

As with other types of antennas, the parts of the antenna that have the greatest amounts of rf current in them should be as high and in the clear as is possible. Supporting a wire vertically would put the rf current part of the antenna as high as possible (see Fig. 3). Half-wavelength vertical antennas work well and are practical on the higher bands. They provide the low-angle radiation needed for working DX.

Antennas do not have to be supported in a straight line. Inverted vee, inverted L, or other configurations can be used. W8BVU once had an antenna the top of which was taped to a bamboo fishing pole. The wire had several curves going from the antenna tuner up to the bamboo pole. W8BVU called it the Chinese Snake Antenna.

For protection against lightning damage, a means of grounding the antenna when it is not in use should be provided outside of the building (see Fig. 4). Note the SPDT switch and the separate earth ground used for this lightning protection.

Two circuits for an antenna tuner to provide rf voltage to feed an endfed resonant-length wire are shown in Fig. 5. The variable capacitor in series with the primary coil (L_1) is helpful in reducing the swr between the transmitter and the antenna tuner. Plug-in coils can be wound on plug-in coil forms or

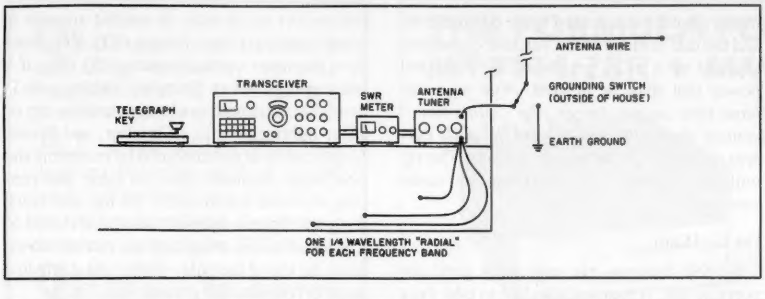
ANTENNA WIRE
TRANSCEIVER
TELEGRAPH KEY
SWR METER
ANTENNA TUNER
GROUNDING SWITCH (OUTSIDE OF HOUSE)
EARTH GROUND
ONE 1/4 WAVELENGTH "RADIAL" FOR EACH FREQUENCY BAND

Fig. 4. Protect your station against lightning damage with a grounding switch mounted outside of the house.

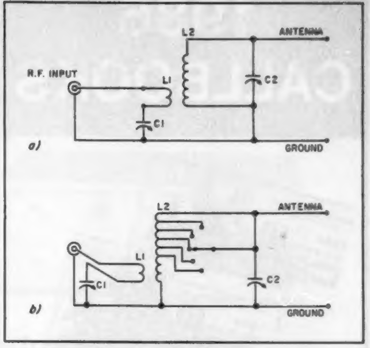

Fig. 5. Circuits of simple tuners suitable for feeding rf voltage to one end of a resonant-length antenna wire. The tuner in a) utilizes plug-in coils, while the circuit shown in b) uses a more convenient tapped coil. (These tuners will not work with a random-length antenna wire.)

on the bases of burned-out tubes, sometimes made longer with cardboard tubing. It's not necessary to have a coil for each band. One coil would cover 1.8–4 MHz, another 7–10.15 MHz, a third 14–21.5 MHz, and the fourth 21–30 MHz. For best results, the parallel-tuned coil and capacitor combination should have a relatively large inductance tuned to resonance by a relatively small capacitance. (See the sidebar on coils and capacitors.)

Those of us who have an antenna tuner with a single-wire terminal can easily try out an antenna that does not have a feedline. We can string up a random, but reasonable, length of wire as high as possible, bring one end into the shack, connect it to the single-wire terminal of the antenna tuner, load it up, and go on the air.

A good grounding system (sometimes called a "counterpoise") connected to the ground post of the antenna tuner is a *must* when you're using any endfed antenna. Such a grounding system can be made by connecting quarter-wavelength wires to the antenna tuner's ground post (one wire for each band on which the antenna is to be used). Table 1 gives quarter wavelengths of commonly used bands. The far ends of these wires should be taped with electrician's tape because they might be hot with rf when the rig is transmitting.

These wires can be located inside the house, running along the baseboards of rooms (for example), or they can be run outside of the house near the ground. These radials help prevent rf-in-the-shack problems and equipment hot with rf. (William I. Orr W6SAI and Stuart D. Cowan W2LX, in their book, *Simple Low-cost Wire Antennas*, have an excellent chapter on endfed antennas: Chapter 8, "The End-Fed, Multi-Band Antenna." This chapter emphasizes the importance of ground radials and describes a simple L-net antenna tuner for use with endfed antennas. This book is one of the best in my antenna library.)

1.8 MHz	120 to 130 feet
3.5 MHz	63 to 66 feet
7 MHz	32-1/2 to 33 feet
10 MHz	21 to 22-1/2 feet
14 MHz	16 to 17 feet
21 MHz	11 to 12 feet
28 MHz	8 to 8-1/2 feet

Table 1. Quarter wavelengths for each band.

An important characteristic of endfed antennas is that they can be used on several bands. Such antennas should be at least a quarter wavelength long for the lowest band on which they will be used. For example, an antenna for the 3.5–4-MHz band and higher bands should run at least 65 feet, and 90 to 100 feet would be even better.

A good length for bands 14 MHz and higher would be 45 to 50 feet. Such an antenna would work also on the 7- and 10.1-MHz bands. For gain in the direction of the wire on the 14-MHz and higher bands, the endfed antenna should be several hundred feet long—the longer the better.

Loading the Endfed

The output of the transmitter (transceiver) goes through the swr meter into the antenna tuner's input. The endfed antenna is connected to the single-wire terminal of the antenna tuner (see Fig. 4). Using low rf power from the transmitter, carefully adjust the inductance and variable capacitance of the antenna tuner for the greatest amount of forward power with the least amount of reflected power. (Follow the directions that came with the tuner.) It will be possible to find settings on the tuner that will result in much forward power with little or no reflected power.

After you've made these adjustments using low power, the rf power output of the trans-

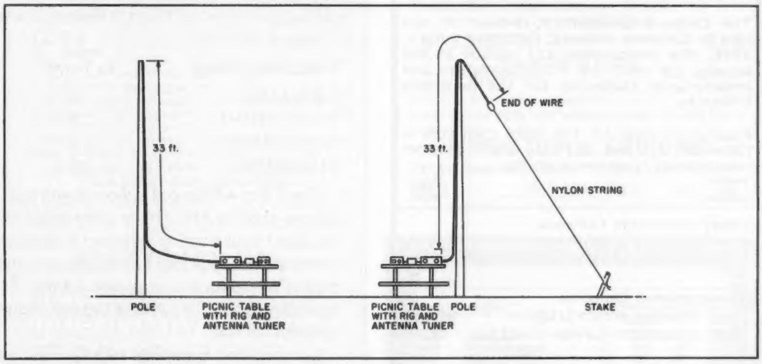
33 ft.
POLE
PICNIC TABLE WITH RIG AND ANTENNA TUNER
END OF WIRE
33 ft.
NYLON STRING
PICNIC TABLE WITH RIG AND ANTENNA TUNER
POLE
STAKE

Fig. 6. Twenty-meter vertical resonant-wire antennas.

HARMONICS

Harmonic frequencies of an antenna of a given length are not exact multiples of the fundamental frequency. They are higher than the fundamental frequency multiplied by the number of the harmonic. For example, the second harmonic of an antenna length that is a half wavelength long at a frequency of 3510 kHz is greater than 7020 kHz. This is because there is less "end effect" on the harmonic frequencies. (See the 14th edition of the ARRL *Antenna Book*, p. 2-7, "Length of a Harmonic Wire.") Therefore, it is a good idea to make a resonant endfed antenna the correct length for a frequency near the low end of the lowest band on which the antenna is to be used. This is so that its harmonic frequencies will not be too high. The antenna tuner provides some adjustments for the higher frequencies of the lowest band to be used, and on the harmonic bands of the antenna.

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mitter should be increased to the desired level and the dial settings of the variable capacitors touched up a bit to get rid of any reflected power that may be present. *With rigs that have tube output stages, the "plate-tune" control should be checked and the plate current "dipped" to the lowest amount.* The rig will then be ready to go on the air and make contacts.

On the Road

Endfed antennas are especially good for portable use. Amateurs who like to take their radio equipment with them on camping trips can use endfed antennas to good advantage. For example, at a weekend camp-out in a northern Michigan trailer camp, W8BVU put his receiver, transmitter, and antenna tuner on a picnic table. Using an endfed 33-foot antenna wire supported vertically by some light lumber and a long fishing pole, he had his usual Saturday-morning schedule with W7WV in Scottsdale, Arizona. In June, 1985, I set up a QRP station in a cabin in Colorado. With a 67-foot endfed antenna and 6 Watts of rf, I joined my regular Tuesday-evening net and worked stations in St. Louis, Missouri; Dickinson, Texas; and Silver City, New Mexico.

It's fun to take a small battery-operated transceiver on picnics; an endfed antenna is ideal for this activity. It's not difficult to hold up a 20-meter vertical antenna (33 feet) if a telescoping 20-foot fiberglass fishing pole is available. The pole can be mounted on top of other lightweight bits of lumber, and excess length can be accommodated by mounting the pole some distance from the table and running the wire horizontally for the necessary distance. Excess wire also can be attached to a piece of nylon string and run out and down from the top of the pole—fasten the string to a stake driven into the ground (see Fig. 6).

For the lower bands, the light wood and fishing pole combination could be used to hold up the center of a longer endfed wire in the form of an inverted vee.

It would be fun to use as an endfed antenna a piece of fine wire suspended vertically from the string of a high-flying kite. Marconi communicated across the Atlantic Ocean with a kite-supported antenna. Perhaps you could, too!

If you have never done so, you owe it to yourself to try an antenna that has no feedline losses. Get the high rf part (or parts) of the antenna way up in the air and enjoy the good QSOs that it will provide on two or more bands. It might be the best antenna that you ever had. ■

ENDFED ANTENNA TUNER COIL AND VARIABLE CAPACITOR INFORMATION
(Resonant-Length Wires Only)

C_1 is a two- or three-gang broadcast band variable capacitor with all of its stator sections connected in parallel.

C_2 is a variable capacitor with wide enough spacing between its plates to withstand the rf voltage that will be applied to it without arcing. Its value should be at least 100 pF. A vernier dial on this capacitor helps in making fine adjustments.

Plug-in coil data:

Frequency Range	L_1 Turns	L_2 Turns	Diameter of Coil Form
1.8 to 4 MHz	5	35	1-1/2 inches
7 to 10.15 MHz	3	10	1-1/2 inches
14 to 21.5 MHz	2	5	1-1/2 inches
21 to 30 MHz	2	4	1 to 1-1/4 inches

The 1.8-to-4-MHz coil is wound with #22 wire, either DSC or enameled. Heavier insulated wire such as #18, #16, or even larger can be used on the other coils. L_1 is made of #14 insulated house-wiring wire and is close-wound over the ground end of L_2. If plug-in coil forms are not available, the bases of burned-out tubes can be used and made longer by means of cardboard or plastic tubing. The inductance of L_2 can be made smaller by spreading apart the turns of the coil. Squeezing the turns together increases the inductance of the coil.

L_2 connected in parallel with C_2 *must* tune to resonance at the frequency being used. This can be checked with a grid-dip meter. If none is available, one side of a neon bulb can be connected to the antenna post of the tuner. When rf from the transmitter is going into the tuner, the neon tube will glow when resonance at the frequency being used is attained by adjusting C_2. (Before the days of swr meters, "neon-tube tuning" was used to indicate rf voltage for endfeeding resonant-length antennas.) The diameter of the coil form can be different from those shown. If the diameter is greater, fewer turns on L_2 are needed. If the diameter is less, perhaps a turn or so more may be needed. The main consideration is that C_2 and L_2 must be of such values that they will tune to resonance at the frequency being used.

For the tapped coil, the coil form can be a piece of wooden dowel 1 to 1-1/2 inches in diameter that has been boiled in paraffin. Plastic, ceramic, or cardboard coil forms can also be used. The secondary (L_2) should have 35 turns tapped at 3, 5, 7, 9, 11, 13, 18, 25, 30, and 35 turns. If there are more positions on the switch, there could be more taps on the coil. The primary (L_1) should be close-wound over the ground end of L_2. Insulated wire #22 or larger should be used in winding L_2. Number 14 insulated house-wiring wire can be used for L_1.

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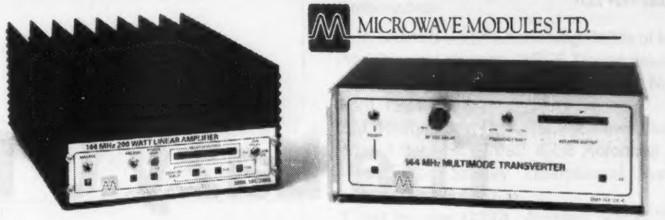
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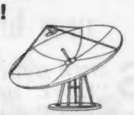

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The Lazy U Dipole

VE7BS's Lazy Z takes on a new bent.

Several years ago I described a sort of "Lazy Z" antenna in use on 160 meters. Pat Hawker G3VA commented on it in *Radio Communications*, a reader tried it on 40 meters and reported promising results, and Bill Orr mentioned it in his column in *Ham Radio*. Somewhere along the line it had become the "VE7BS Antenna," but by this time I had come to the conclusion that the "Lazy U" (described below) worked rather better.

The VE7BS was basically a half-wave dipole bent in the right places (see Fig. 1). The arrows show the direction of current flow at a given moment, and you can see that the two end sections are in phase with each other. Most of the radiation is from the center section where the current is higher, so the contribution of the end sections is not that great, and they are too close to each other to give any broadside gain. But this configuration does make it possible to have the main radiating portion at a relatively steep angle while preserving the useful bandwidth of a full-length dipole.

A straight sloping half-wave dipole 240 feet long suspended from a 100-foot-high support thinks of itself as a horizontal dipole 50 feet high and fires mostly straight up on 160. A bit of geometry or a scale drawing shows why—even if the wire were tight and straight, it would be only 24 degrees from the horizontal.

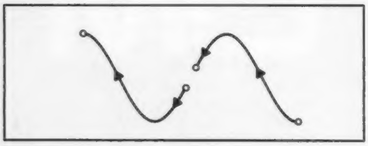

Fig. 1.

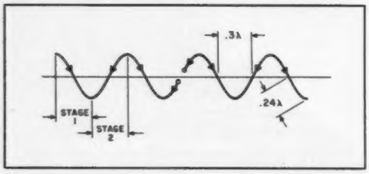

Fig. 2.

All this came to mind when W4KM brought to my attention an interesting item that appeared in *Radio* (published in the USSR), describing the "snake antenna" used by UY5AP for communication via satellites on 144 MHz (see Fig. 2). UY5AP's antenna is made with rigid coaxial cable, using the sheath as a fat conductor (3/8" or 1/2" copper pipe would be an ideal material to use for this kind of construction). It is described as a "seven-stage synphase" antenna, with a figure-8 pattern in the horizontal plane and a narrow lobe toward the horizon in the vertical plane. Bear in mind that this is on 144 MHz, so presumably the antenna is mounted several wavelengths above ground.

The dimensions given in *Radio* show that each stage is a half wave long, slightly shortened to allow for the diameter/length ratio, and the distance between each stage is a 5/16 wave.

In effect, then, we have seven close-spaced elements in phase as far as vertical polarization is concerned, but each stage is in antiphase to its neighbor as far as horizontal polarization is concerned. I came to this conclusion by playing with current-flow arrows, as illustrated in Fig. 3.

You can look upon it also as a pair of cross-polarized stacks with four elements copolarized and three others in quadrature with them. Maybe, with four in one direction and three in the other, this could be said to be elliptical? (See Fig. 4.)

This is all very interesting for the 2-meter satellite enthusiast, but for me VHF is an abstraction. To erect such an antenna for an HF band requires a rather long line of trees, but it doesn't *have* to be seven stages long, does it! After all, not all yagis have 60-foot booms, but there are lots of yagis around.

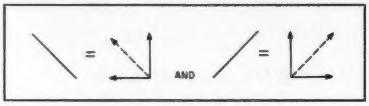

Fig. 3.

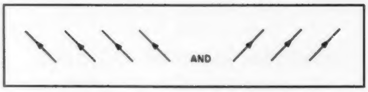

Fig. 4.

How about three stages? With a basically vertically polarized array it can be close to the ground without suffering ill effects, and for 40 meters a three-stage "snake" would be about 150 feet long and could be hung on supports 50 feet high. It would need only two such supports, because one end of the snake is close to the ground (see Fig. 5).

There are definite advantages to having an antenna that has cross-polarized elements. All signals coming via the ionosphere rotate on the way, and the degree of rotation is unpredictable. It is because of this rotation that you can get good signals (most of the time) on your horizontal antenna although the other fellow is using a vertical. But some of the QSB you suffer comes from the rotation of the signal, and if your antenna can respond to any polarization, you suffer less. I don't recall seeing anything about this antenna arrangement in the literature, although it seems impossible that Kraus and Sterba and Franklin and company could have overlooked it in the heyday of linear arrays for HF in the thirties.

The seven-stage VHF snake has a feedpoint impedance of 300 Ohms, so it is fed

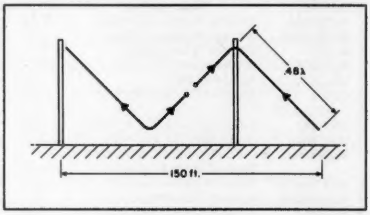

Fig. 5.

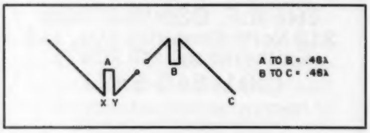

Fig. 6.

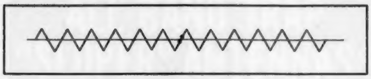

Fig. 7.

with 300-Ohm balanced feeder or with 75-Ohm coaxial cable through a 4:1 coaxial balun. In the three-stage HF version, the feedpoint impedance is between 100 and 125 Ohms. A quarter-wave section of 75-Ohm transmission line transforms nicely from 50-Ohm cable to the feedpoint impedance.

The wire is supported at the bends by insulators and a short piece of ABS tubing to keep the bend from being too sharp, so each "element" is 468/f long to allow for end effect. If available height or space is a bit short, there are some interesting possibilities in folding at the corners, as shown in Fig. 6. Points X and Y are at the same potential and sign, and so can be tied together without harming the resonance. But that's a complication.

A Japanese Snake

In 1984, a short item appeared in the IEEE literature[1] describing the results obtained from bending the wire of a dipole in zigzag fashion, but in this case at more frequent intervals than with the "synphase" just discussed. Starting with a length of wire a half wavelength long, it is bent as shown in Fig. 7 to make each zig or zag .0208 of a wavelength long (12 bends in each half of the dipole).

If the angle of each bend is made 130 degrees, the actual length of the antenna will be shortened by 10% and the antenna will be self-resonant with a feedpoint resistance of 65 Ohms and a negative reactance of about 50 Ohms. The patterns and the half-power bandwidth remain about the same as a straight half-wave dipole, and this stays true if the antenna is shortened further by decreasing the angle at each bend. What is more, the input resistance does not change radically.

For example, if you make the original wire .58 of a wavelength long and then compress it to .4 of a wavelength (20% shorter than a straight half wave), the input resistance is a little less than 50 Ohms, a direct match to RG-8 coax if you use a transmatch to compensate for any reactance that appears.

I suppose a stretched-out Slinky™ would work in a somewhat similar way, although the theory of the close-coiled Slinky is probably different. [*See "The Ramada Radiator" in this issue.—Ed.*] The possibilities of combining the shortening effect of the 24-bends-per-half-wave with the synphase effect of the one-bend-per-half-wave are endless. If you are interested, the basics of the shortening effect are covered in a 1982 IEEE publication[2].

The Lazy U

There are only two bends in the Lazy U variant of the half-wave dipole—see Fig. 8. You make the vertical portion as long as possible (some have been used on 160 meters with as little as 33 feet of vertical) and the top horizontal wire should be directly above (parallel to) the bottom wire. The bottom wire can be as close to the ground as practical convenience allows, but preferably at least six feet up; remember that there is a high rf potential at the end!

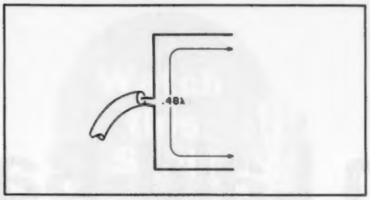

Fig. 8.

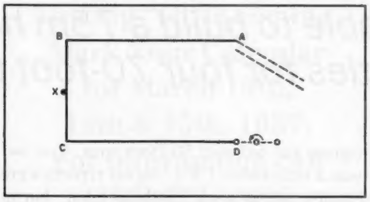

Fig. 9

Radiation is effectively vertically polarized. Maximum current flows in the vertical portion, and experiments have shown that a displacement current flows between the upper wire and the lower (in effect, counterpoise) wire, creating a whole raft of phantom verticals.

It is much quieter than a vertical monopole on receive, and I have a special affection for it because it gave me my first African contact from VE7 on 160. (That particular antenna had about 90 feet of vertical, but one with 60 feet of vertical worked about the same.)

Bring the coax away horizontally for a few feet from either the side or the back of the U—a few turns of coax wound as a choke near the feedpoint will prevent antenna currents from running on the outside of the coax shield.

It is more or less a single-band antenna, but was derived from the multiband G8ON[3, 4]—see Fig. 9. A to D is a half wavelength; on harmonic frequencies, X to D is an odd number of quarter wavelengths. X is the center of a half-wave section, the point of maximum current. AB and CD are equal, and AB is parallel to CD. CD is, in effect, a counterpoise, at least six feet above the ground. The dotted portion is a single-wire feeder—it could be open-wire zepp.

To use it on higher frequencies, you put suitable lengths of wire as extensions at D to create a current maximum at X (make the point X an odd number of quarter waves from the *far end*—point D).

A General Reminder

When you make a bend in a resonant antenna, make it as gradually as possible. A sharp corner tends to look something like a termination to the rf current arriving at it. Although the general idea is that you want the current to jump off some time in the direction of the other station, you also want it to recognize what frequency the antenna is designed for!

Have fun bending! ■

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1. H. Nakano et al, "Shortening Ratios of Modified Dipole Antennas," *IEEE Transactions on Antenna and Propagation*, Vol. AP-32, No. 4, April, 1984.
2. J. Rashed and C. T. Tai, "A New Class of Wire Antennas," *1982 IEEE Antennas and Propagation Society International Symposium Digest*, Vol. 2.
3. Pat Hawker G3VA, *Amateur Radio Techniques*.
4. VE7BS, "Wire Antennas," *The Canadian Amateur*, March and April, 1979.

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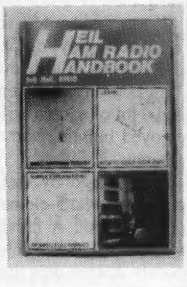

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The 75m Laid-Back Quad

Unable to build a 75m helix, N4VD settles for four 70-foot pine trees.

When I removed the February, 1985, issue of *73* from my mailbox, I was excited to see a picture of Ollie W1ZB standing beside a 20-meter helix. You see, I have a fetish about adapting VHF-style antennas to HF use. Ollie hit an experimental nerve in me, and I immediately went out looking for something between the size of a water tower and the Astrodome around which I could wind a 75-meter helix.

It must come as no surprise to anyone that I have yet to find a suitable cylindrical object that will serve as a winding form for such a corkscrew. Frustrated by the search, I retired to my deck one evening to grill hamburgers, drink 807s, and fondly recall past antenna successes. (Speaking of grilling hamburgers on the deck—it occurs to me that people used to cook in the house but go outside to use the bathroom. In today's society, we cook in the yard, then go inside to tend to our needs!)

I once built a 5/8-wavelength vertical for 75 meters. Boy, did it work like a champ! I even wrote an article about it for *73* ("The 75m DX Chaser Antenna," June, 1978) and had a lot of people write to tell me how they enjoyed building and using this unorthodox antenna.

Encouraged by that success, I set about constructing a 5-element, 75-meter log periodic antenna. A hundred dollars' worth of wire later, I had an antenna that performed so poorly that the only thing to receive my "CQ DX 75" was my neighbor's garage-door opener.

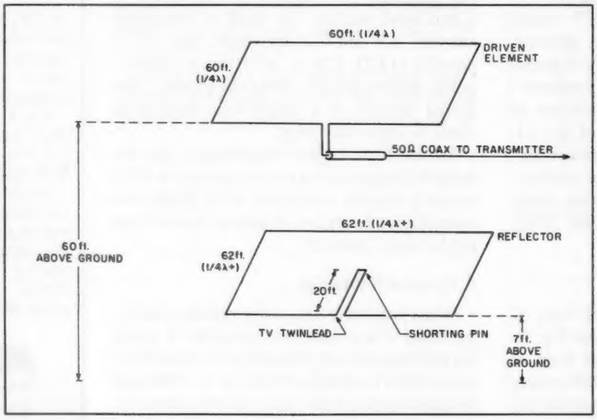

Fig. 1. The 75-meter laid-back quad.

Not easily discouraged, I dug around in my 1939-vintage antenna handbook and came acoss (in, of all chapters, "Mobile Antennas") a "squalo" for 2-meter AM work. Said to be unidirectional, the squalo appeared to have possibilities for low-band work. Rotators for 75-meter arrays can, after all, get somewhat large and expensive if you don't happen to be the owner of a diesel engine shop.

Blessed with 70-foot-tall Carolina pine trees, I set about hoisting a 75-meter squalo up to the 60-foot level. It was 60 feet on each of the four sides of the square and fed with 50-Ohm coax. The swr was a reasonable 1.8:1. Signal reports were equally encouraging (nothing great, but at least as good as my inverted vee at the same height).

Proud of my work, I showed off the squalo to my father, WA4GBE. He studied it for a minute or so and then, displaying the wisdom of his years, said, "It's nothing but the driven element of a quad, laid on its back. Why don't you put a reflector element under it, and you can shoot 6 or 7 dB straight up into the sky?" It hurts when the ole block you're supposed to be a chip off of walks away laughing about 6 or 7 dB being hurled up into the clouds.

When he was safely out of sight, I regained my composure, did a quick calculation using a stick in the dirt, and determined that a reflector placed 0.2 wavelengths under the squalo would be located conveniently within arm's reach, only about 7 feet or so above the ground. 75-meter local signals (those that skip around in your own call district) are a product of atmospheric scatter. I deduced that an extra 6 or 7 dB of signal sent up might result in a good deal of it coming back down.

A reflector loop for a quad needs to be longer in length than the driven element. My pine trees were just far enough apart for the 60-foot-per-side driven element, making it difficult to come up with a way to fit a somewhat larger reflector into the same space. I considered loading coils, but it seemed much simpler just to get it as large as the space permitted and let a tuning stub make up the difference. A piece of TV twinlead was attached to the reflector and pulled along head high toward the center of the square.

Beginning 10 feet or so from its attachment to the reflector element, I began sticking a pin through the twinlead, thereby shorting together the two plastic-encased wires. My swr reading was up around 3.0:1 when I first checked it. Moving the pin a foot at a time, I finally found a point about 18 feet down the twinlead where the swr was back to a respectable level between 1.5:1 and 2.0:1.

Read on to the next paragraph—it's the old "tried it on the air and got nothing but 40 over 9 signal reports" testimonial!

The original squalo was roughly equal in performance to my inverted vee, making a test of the virtues of the "laid-back quad" fairly easy. Sure enough, on-the-air tests showed that a goodly portion of the theoretical 6 or 7 dB blasting off into the atmosphere was making its way back down to add to the QRM on 75 meters. It didn't do as much for my signal as when I added "Godzilla" (the old 4-1000A amplifier I drove with an SB-200) to the quad a year before, but it was good for one to two S-units over the inverted vee.

Not everyone has four conveniently located 70-foot pine trees with which to work. Even 45–50-foot supports will work well if the reflector is placed on the ground or slightly under the surface (known as a worm warmer). I once used this method at another QTH and found its performance equal to the above-ground version. I have talked about this antenna quite a bit on the air, and one day a fellow in Minnesota broke into a QSO to tell me he had tried my design but with a delta-loop arrangement since he had only three tall supports. According to him, it also was a real "signal pumper." His signal supported the claim.

Ollie, I'm still looking around for just the right cylindrical object to use as a winding form for my 75-meter helix. If you think of anything, let me know. ■

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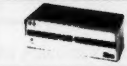

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David Whitby
c/o 73 Magazine

Kit Corner: Build A Two-Tube Vintage Receiver

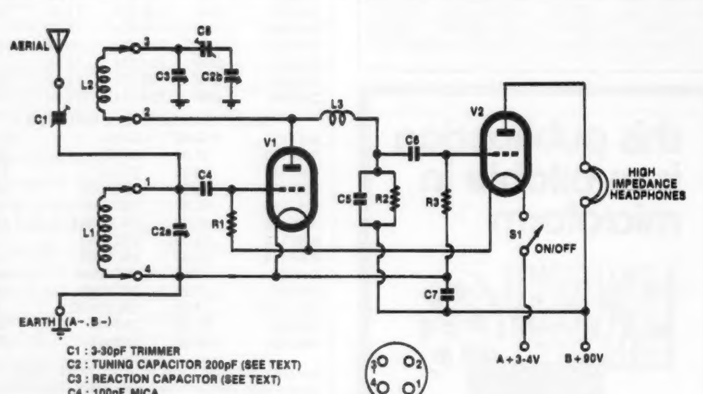
Excerpted with permission from Electronics Australia.

Of all the sets built by hobbyists since the 1920s, the allband one- or two-tube sets with plug-in coils were probably the most popular. Of these, the Reinartz circuit (Fig. 1) was undoubtedly the best known.

The basic circuit was devised by J. L. Reinartz and was published in the June, 1921, issue of *QST*. The set was of the "leaky-grid" regenerative detector type. It employed a spider-web coil with switched taps to cover various bands, and featured variable-capacitor control of the regeneration. It was this capacitive control that was the main distinguishing feature of the Reinartz circuit.

Previous methods of regeneration control included the "swinging reaction coil," the tuned-anode variometer, and other methods which used a fixed-reaction coil coupled to the tuning coil and which controlled the amount of reaction by varying the filament or anode voltage of the tube.

All of these methods worked (some more so than others) on the long and medium wavelengths, but when it came to operation on the shorter bands, the reaction control became very tricky. An unstable receiver was often the result. The Reinartz circuit quickly became popular mainly due to the smooth reaction control on the shorter wavelengths.



C1 : 3-30pF TRIMMER
C2 : TUNING CAPACITOR 200pF (SEE TEXT)
C3 : REACTION CAPACITOR (SEE TEXT)
C4 : 100pF MICA
C5 : .001 MICA
C6 : .01
C7 : .001 MICA
C8 : 3-30pF TRIMMER
R1 : 3M
R2 : 50-100k
R3 : 500k-1M
L3 : 2.5mH RFC
V1,V2 : MEDIUM IMPEDANCE TRIODE
HL2K (VT50) (SEE TEXT)

Fig. 1. Schematic diagram of the Reinartz all-wave receiver.

Simply explained, the reaction capacitor is in series with the reaction coil and is thus able to control the rf current through this coil. Adjustment of the capacitor provides precise control of the amount of positive feedback (regeneration) in the circuit.

Circuit Details

Take a look at the circuit in Fig. 1. Signals from the aerial are coupled via C1 into the tuned circuit comprising L1 and C2A. Frequencies selected by the tuned circuit are detected by the grid of V1 which, together with C4 and R1, forms a leaky-grid detector. To improve the sensitivity of the detector to weak signals, grid-leak resistor R1 is connected to the positive side of V1's filament.

Regeneration is accomplished by the combination of L2 and C3, which feeds back some of the rf energy in such a way as to aid the original signal and bring about a great increase in gain and selectivity. The setting of C3 controls the amount of regeneration, with the optimum setting being just short of the point of oscillation (marked by a high-pitched howl).

L3 is an rf choke that prevents loading of the regeneration system by the following stage. It also operates in conjunction with bypass capacitor C5 to prevent rf currents from passing to the output stage. An rf choke in this position is always a feature of the Reinartz circuit.

Audio signals developed across V1's load resistor (R2) are coupled via C6 into the grid of V2, which drives the headphones.

It should be noted that the filaments are connected in series. This is done to provide an effective negative grid bias voltage for V2, obtained by virtue of the fact that both sides of V2's filament are positive with respect to the grid, which is at ground potential through R3.

C7 is an rf bypass capacitor across the B supply, and S1 switches power to the set by making or breaking the filament supply. The set requires an A battery of 3.4–5 volts at 100 mA, and a B battery of about 90 volts at 1.5 mA. Two heavy-duty D cells provide a suitable supply for the filaments, while a string of ten 9-V batteries will handle the B requirement.

The radio is built on a Meranti wood base, which has a "cove" routed edge. The tuning and reaction controls, the power switch, and the headphone jack are mounted on a front panel of gold-lettered black Bakelite™. A rear sub-panel, also of Bakelite, holds most of the other components, including the coil and tube sockets, and the terminals for the aerial and power supply connections.

> ***". . . with correctly adjusted regeneration, the set performs as well as much larger sets do without regeneration."***

On the Air

For best results, an outdoor aerial of from 10 to 30 meters long, mounted as high as possible, is desirable. However, quite respectable results can be achieved with a good indoor aerial in many locations.

When you are trying the set on any band for the first time, start with the reaction capacitor plates fully out of mesh and vary the setting of the tuning capacitor. You will probably hear some stations, though they will sound weak.

Now tune so that the station you want comes in as loudly as is possible. Then gradually turn the reaction capacitor so that the plates mesh. The loudness of the signal will increase as you do this, and if you now check the setting of the tuning capacitor you will find that it has shifted slightly. After a little practice, you will be able to tune the set very accurately in just a few seconds.

At the higher frequencies, the setting of both controls becomes more critical, and more skill is required to obtain the best results. You may find it easiest to make tuning a two-handed job. In any case, it is interesting to note that with correctly adjusted regeneration, the set performs as well as much larger sets do without regeneration.

Build the Kit

Dick Smith Electronics offers a complete kit for construction of the two-tube Reinartz receiver, including four hand-wound coils which cover 560 kHz to 19 MHz. Order kit number K-9000 ($99.95 plus $5 shipping) from Dick Smith Electronics, PO Box 2249, Redwood City CA 94064; (800)-332-5373.■

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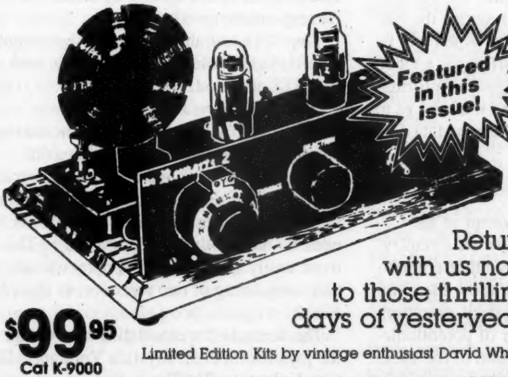
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Keeping NiCd batteries at their peak performance involves more than just charging them every night. It's nice to think that this always will make your hand-held radio ready to go the next day, but the fact is that NiCds require a periodic deep discharge to avoid a reduction in their charge capacity.

This is easy to do with a single cell—just put a load on it and wait until cell voltage drops to zero—but doing the same with multi-cell batteries can ruin them. The weak cells (which discharge first) continue to get the current from the good cells, but in a direction which reverses their cell voltage. This results in permanent damage.

Since usually we cannot disassemble a multi-cell battery into individual cells, this leaves the problem of how to discharge the battery by just the right amount—not too much, not too little. The usual rule of thumb is to monitor the battery voltage during discharge and disconnect the load when the total battery voltage drops to about 1.0 or 1.1 volts per cell. For example, a NiCd rated at 10.8 volts has nine cells; we can determine this by knowing that the rated output voltage of a single NiCd cell is 1.2 volts and 10.8 divided by 1.2 is 9. We should, therefore, stop discharging such a battery somewhere between 9.0 and 9.9 volts.

What we need, then, is a circuit which will monitor the battery voltage and disconnect the load as soon as the voltage drops to the required value. In addition, it might be useful if this circuit also could keep records on battery voltage during discharge and tell us how long it took to discharge the battery. This information could tell us what shape the battery is in. This is where a computer can become very useful, as it can completely automate a process which could take several hours, make sure to discharge the battery enough to be useful but prevent excessive discharge, and keep printed records as well.

As it turns out, the CoCo has some circuitry which makes it a natural for this job. It has a built-in analog-to-digital (A/D) converter which can be used to monitor the battery voltage and it has a relay which can be used to turn the load on and off. It has a video display which can be used to give us information about what it is doing, and it allows us to print a permanent record of battery data on a printer.

The A/D Converter

The analog-to-digital converter in the CoCo is actually part of the joystick circuitry. Unlike the joysticks on many other computers, which use switches and allow the computer to detect only the joystick direction, those on the CoCo use a pair of potentiometers which turn with the position of the stick. One pot monitors left-right movement while the other monitors movement forward and back. In addition to direction, the computer actually can determine how far the joystick has been moved.

Internally, the joystick potentiometers are connected as shown in Fig. 1. Each joystick pot is connected between +5 volts and ground and outputs a voltage ranging from 0 volts at the bottom to +5 volts at the top. Since there are four pots (two in each joystick) and only one A/D converter, a 4-input multiplexer is in the middle. The multiplexer acts like a 4-pole selector switch which chooses which pot signal is fed to the A/D converter at any one time.

The A/D converter converts the input voltage into a 6-bit binary number. The largest 6-bit binary number is 111111, the equivalent to a decimal 63, so 0 volts corresponds to an A/D output of 0, while +5 volts corresponds to an output of 63.

The A/D output values can be sampled directly from Color Computer Basic with the JOYSTK function. For example,

A = JOYSTK(0)

would make A equal to the value obtained from the first potentiometer, and so on.

Since the A/D converter accepts a maximum input of +5 volts, and most hand-held radio batteries run between 7 and 15 volts, we need to reduce the applied voltage. This is most easily done with a simple voltage divider consisting of two resistors, as shown in Fig. 2.

The formula for calculating the voltage to the joystick input is: Joystick Voltage = Battery Voltage x Rb/(Ra + Rb). If only standard value resistors are used, it may not be possible to reduce the voltage to just the right amount. For example, with the resistors shown, this circuit cuts down the 15 volts of a battery to about 4.7 volts (depending on the exact resistor values). As it turns out, this is ideal because 15-volt batteries provide over 16 volts just after being fully charged. Assuming the resistors are exactly the rated values, this circuit will drop 16 volts down to exactly 5 volts, but the exact voltage drop will depend on the exact resistor values.

Knowing that a 16-volt input produces an output of 63 from the A/D converter, we need some

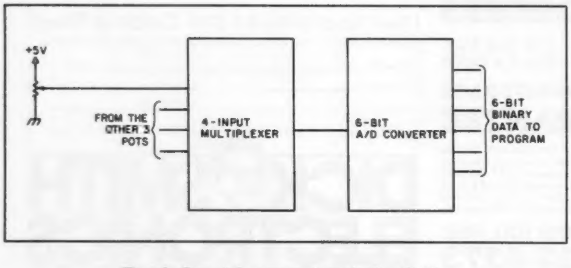


Fig. 1. Joystick connections in the CoCo.

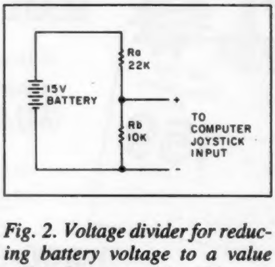
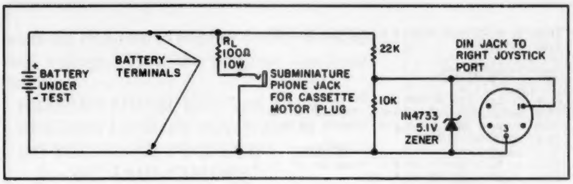


Fig. 2. Voltage divider for reducing battery voltage to a value within the range of the A/D.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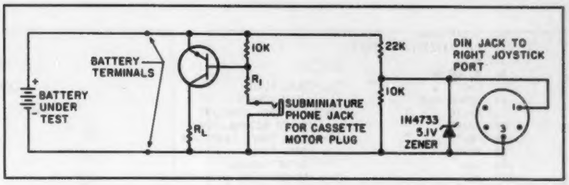
10K
1N4733
5.1V
ZENER
DIN JACK TO RIGHT JOYSTICK PORT
1
3

Fig. 3. Complete circuit.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ZENER
DIN JACK TO RIGHT JOYSTICK PORT
1
3

Fig. 4. Modified circuit for higher discharge current.

way of computing the voltage if we know the joystick A/D converter output. This is simply done by multiplying the A/D number by a constant, K, where K is found from the formula: K = Full-scale Voltage/63 = 16/63 = 0.254. Multiplying a reading of 63 by 0.254 gives us 16 volts.

As before, this is the theoretical formula, but in practice a slightly different value for K may be needed because of resistor errors. This may require a calibration procedure, described later. (For example, in my system, I use K = 0.26. The maximum voltage reading then becomes 63 x 0.26, or 16.38 volts.)

Since the A/D output is always an integer between 0 and 63, it changes only in steps of 1. Hence, the measured voltage changes in steps of K volts. For example, if I input 15 volts into the circuit in my system, my A/D converter outputs a value of 58. I then multiply this value by 0.26, which gives me a value of 15.08 volts instead of exactly 15 volts.

Notice that the resulting value is not entirely correct. This is due to the fact that a 6-bit A/D converter has only 64 different possible output values, ranging from 0 to 63. This splits the allowable voltage range into 64 possible values, and the A/D converter cannot measure any closer than that. In my particular unit, the minimum voltage reading is 0.26 times 0, or 0 volts. The next higher indication occurs when the A/D converter outputs a 1, which translates into a voltage of 0.26 times 1, or 0.26 volts. Any voltage below 0.26 volts will always read as 0; any voltage between 0.26 volts and 0.52 volts will always read as 0.26 volts, and so on. This means that any computer voltage measurement can always be off by as many as K volts.

Though this is not the world's greatest accuracy, it is certainly good enough to monitor the voltage of a battery to a reasonable accuracy.

The Load Relay

The second essential part needed for this application is a relay which can be used to control battery charge and discharge. In the case of the CoCo, such a relay is already built in—it's intended to turn a cassette-recorder motor on and off. The only disadvantage is that the relay's current-handling capacity is limited.

Although Radio Shack does not specify the rating of the cassette motor relay, my guess would be that it can handle 250 milliamperes safely, and perhaps as much as 500 mA. As long as we make sure not to exceed this current, there is no problem. The relay can be controlled quite easily from Basic with the two statements, MOTOR ON (to close the contacts) and MOTOR OFF (to open them).

The Full Circuit

When we put these two parts together, we get the circuit in Fig. 3. The circuit uses a 100-Ohm, 10-Watt, wire-wound resistor as the load resistor, R_L. To simplify connection to the computer's cassette motor relay, we put a subminiature phone jack (Radio Shack 274-292) in series with the resistor; this matched the subminiature plug at the end of the cassette cable.

The output of the voltage divider connects to the right joystick port through a DIN connector (Radio Shack 274-020), as shown in the diagram. An optional 5.1-volt zener diode (Radio Shack 276-565) protects the joystick input from accidental application of voltages above 5.1 volts or below zero.

I chose a 100-Ohm load resistor (Radio Shack 271-135) in order to limit the maximum current through the cassette-relay contacts. The maximum current can be found from Ohm's Law as Maximum Current = Battery Voltage/R_L. With a 15-volt battery, this current works out to 0.15 Amperes, or 150 milliamperes. This current will discharge a 450-mAh battery in approximately three hours.

Since discharge current depends on the battery voltage, batteries with a lower voltage will discharge more slowly. Table 1 gives figures for a few typical hand-held radio batteries.

This seems like a reasonable compromise between circuit simplicity and discharge time, but it is possible to lower the value of R_L as long as the relay current does not go past about 250 mA. (If you insist on discharging your battery faster, then you must modify the circuit by either adding a second relay or adding the transistor-switching circuit in Fig. 4. In this circuit, the PNP transistor must be large enough to handle the current without overheating—and should be mounted on a heat sink—and resistor R1 should have a value about 20 times the value of R_L to provide enough base current to the transistor to fully saturate it.)

The Program

The program to control the circuit can be as simple or as complex as you want it. For example, the program to discharge a 15-volt battery to 13 volts and then disconnect the load could be as simple as:

```
10 MOTOR ON
20 V = JOYSTK(0) * 0.26
30 IF V > = 13 THEN GOTO 20
40 MOTOR OFF
```

This program simply closes the motor relay and then loops in lines 20 and 30 as long as the battery voltage is 13 volts or more. Once the voltage drops below 13 volts, it goes to line 40 and shuts off the load by opening the motor relay. Though the above program works, the computer is capable of doing much more. The program listing shows the program I use.

When you start the program, the first screen is a menu listing the possible choices at that point. You may get the following menu at any time by pressing the H (Help) key:

```
BATTERY TEST PROGRAM
BY PETER A. STARK K2OAW
C—CALIBRATE
H—HELP
L—TURN LOAD ON
N—TURN LOAD OFF
P—PRINT ON PRINTER
S—START TEST
V—ADJUST VOLTAGE CUTOFF
```

Calibrate. As described earlier, the value of K may have to be adjusted for best accuracy. Although the program sets K equal to 0.26 (my value), another value may be more accurate for your particular combination of resistors. The Calibrate mode lets you adjust K for best results. Simply connect your battery to the circuit, connect an accurate meter across the battery, and press C. The program will display the following:

```
PRESENT CONVERSION CONSTANT
IS .26
ENTER MEASURED VOLTAGE;
(MINUS NUMBER TO QUIT):
```

You should now enter the actual measured battery voltage, and the new value of K will be displayed and placed into the program. (Once you calibrate the voltage reading this way, you may find it more convenient to put the correct value of K into line 70 of the program so you don't have to do the calibration each time you use your circuit.)

Help. You may press H at any time that the

Radio	Battery Rating	Current (mA)	Discharge Time
5-W HT-220	15 V, 450 mAh	150 mA	3 hours
1-W HT-220	15 V, 225 mAh	150 mA	1.5 hours
Yaesu FT-208R	10.8 V, 450 mAh	108 mA	4.2 hours
Kenwood TH-21AT	7.2 V, 180 mAh	72 mA	2.5 hours

Table 1. Ratings for some radio batteries.

```
10   CLEAR 5000
20   DIM T$(255), VO(255)
30   NE=1
40   MOTOR OFF
50   L=0                         'LOAD FLAG
60   GOSUB 1000                  'HELP SCREEN
70   K=.26                       'A/D CONV CONSTANT
80   T=255                       'TIMER ACCUMULATOR
90   P$=""                       'PREV INKEY CHARACTER
100  PT=0                        'PREV TIME
110  C=0                         'CUTOFF VOLAGE
120  M=0                         'REPORT TIME IN MIN*3600
130  PM=0                        'PREV REPORT TIME
140  A$=INKEY$
150  IF A$=P$ THEN 240
160  P$=A$
170  IF A$="C" THEN GOSUB 1500
180  IF A$="H" THEN GOSUB 1000
190  IF A$="L" THEN GOSUB 2000
200  IF A$="N" THEN GOSUB 2500
210  IF A$="P" THEN GOSUB 3000
220  IF A$="S" THEN GOSUB 3500
230  IF A$="V" THEN GOSUB 4000
240  GOSUB 500                   'GET TIME
250  IF T$="" THEN 140
260  PRINT @0, "TIME  ";T$
270  GOSUB 4500                  'READ V
280  PRINT "VOLTAGE "; V
290  PRINT "LOAD ";
300  IF L=0 THEN PRINT "OFF" ELSE PRINT "ON"
310  PRINT "--------------------------------"
320  IF INT(CT/M)=PM THEN 370
330  PM=INT(CT/M)
340  PRINT @480, T$, V
350  IF P=-2 THEN PRINT #-2, T$, V
360  IF NE<256 THEN T$(NE)=T$ : VO(NE)=V : NE=NE+1
370  IF C<>0 AND V<C AND L=1 THEN GOSUB 2500 : SOUND 180,50 : SOUND 200,20
380  GOTO 140

490  ' COMPUTE THE TIME

500  IF T=255 THEN T$="" : RETURN
510  TI=TIMER
520  IF TI<PT THEN T=T+1
530  CT=T*65536+TI
540  PT=TI
550  TI=T*65536+TI
560  A=INT(TI/216000)
570  TI=TI-A*216000
580  GOSUB 680
590  T$=A$+":"
600  A=INT(TI/3600)
610  TI=TI-A*3600
620  GOSUB 680
630  T$=T$+A$+":"
640  A=INT(TI/60)
650  GOSUB 680
660  T$=T$+A$
670  RETURN
680  A1=INT(A/10)
690  A=A-A1*10
700  A$=CHR$(A1+48)+CHR$(A+48)
710  RETURN

1000 'HELP SCREEN

1010 CLS
1020 PRINT "     BATTERY TEST PROGRAM"
1030 PRINT "   BY PETER A. STARK, K2OAW"
1040 PRINT @128
1050 PRINT "C - CALIBRATE"
1060 PRINT "H - HELP"
1070 PRINT "L - TURN LOAD ON"
1080 PRINT "N - TURN LOAD OFF"
1090 PRINT "P - PRINT ON PRINTER"
1100 PRINT "S - START TEST"
1110 PRINT "V - ADJUST VOLTAGE CUTOFF"
1120 RETURN

1500 'CALIBRATE K

1510 IF JOYSTK(0)=0 THEN RETURN ELSE CLS
1520 PRINT "PRESENT CONVERSION CONSTANT IS ", K
1530 PRINT "ENTER MEASURED VOLTAGE; (MINUS  NUMBER TO QUIT)""
1540 INPUT V
1550 IF V<0 THEN 1000
1560 IF V=0 THEN 1580
1570 K=V / JOYSTK(0)
1580 PRINT "NEW CONVERSION CONSTANT IS ", K
1590 RETURN

2000 'TURN ON LOAD

2010 IF L=1 THEN RETURN ELSE L=1
2020 GOSUB 4500 : PRINT @480, "NO LOAD VOLTAGE"; V
2030 IF P=-2 THEN PRINT #-2, "NO LOAD VOLTAGE"; V
2040 MOTOR ON
2050 GOSUB 500                   'GET TIME
2060 IF P=-2 THEN PRINT #-2, "LOAD ON AT  "; T$
2070 PRINT "LOAD ON AT  "; T$
2080 GOSUB 4500 : PRINT "LOADED VOLTAGE"; V
2090 IF P=-2 THEN PRINT #-2, "LOADED VOLTAGE"; V
2100 RETURN

2500 'TURN OFF LOAD

2510 IF L=0 THEN RETURN ELSE L=0
2520 GOSUB 4500 : PRINT @480, "LOADED VOLTAGE"; V
2530 IF P=-2 THEN PRINT #-2, "LOADED VOLTAGE"; V
2540 MOTOR OFF
2550 GOSUB 500                   'GET TIME
2560 IF P=-2 THEN PRINT #-2, "LOAD OFF AT "; T$
2570 PRINT "LOAD OFF AT "; T$
2580 SOUND 230,2
2590 RETURN

2600 'PRINT ON PRINTER
3000 CLS
3010 PRINT "   PRINT MENU" : PRINT
3020 PRINT "P - PRESENT DATA"
3030 PRINT "D - SAVED DATA"
3040 PRINT "G - GRAPH SAVED DATA"
3050 PRINT "ANYTHING ELSE - QUIT"
3060 A$=INKEY$ : IF A$="" THEN 3060
3070 IF A$="P" THEN 3110
3080 IF A$="D" THEN 3170
3090 IF A$="G" THEN 3250
3100 RETURN

3110 'PRINT TIME

3120 GOSUB 500 : GOSUB 4500
3130 IF T$="" THEN RETURN
3140 PRINT #-2, "TIME = "; T$; "   VOLTS ="; V
3150 CLS : RETURN

3160 'PRINT SAVED ARRAY

3170 IF NE=1 THEN CLS : RETURN
3180 PRINT #-2, "TIME", "VOLTS"
3190 FOR I=1 TO NE-1
3200     PRINT #-2, T$(I), VO(I)
3210 NEXT I
3220 PRINT #-2
3230 CLS : RETURN

3240 'GRAPH SAVED DATA

3250 IF NE=1 THEN CLS : RETURN
3260 FOR I=1 TO NE-1
3270     A=INT(VO(I)/K/2 + .1)
3280     IF A>14 THEN PRINT #-2, VO(I); TAB(A); "*"
3290     IF A<=14 THEN PRINT #-2, TAB(A); "*"; TAB(18); VO(I)
3300 NEXT I
3310 PRINT #-2
3320 CLS : RETURN

3500 ' START TEST

3510 CLS : PRINT "STARTING TEST"
3520 GOSUB 4500 : PRINT "PRESENT VOLTAGE IS "; V
3530 PRINT "PRESENT TIME = 00:00:00"
3540 PRINT "HOW OFTEN DO YOU WANT DATA (IN"
3550 INPUT "   MINUTES)"; M
3560 IF M<=0 OR M>60 THEN 3540
3570 M=M*3600
3580 GOSUB 4000                  'GET VOLTAGE CUTOFF DATA
3590 INPUT "REPORT ON TV OR PRINTER"; A$
3600 IF LEFT$(A$,1)="T" THEN P=0 ELSE IF LEFT$(A$,1)="P" THEN P=-2 ELSE GOTO 3590
3610 TIMER = 0 : T=0 : PT = 0
3620 GOSUB 2000
3630 RETURN

4000 'DEFINE NEW VOLTAGE CUTOFF
4010 GOSUB 4500 : PRINT "PRESENT MEASURED VOLTAGE IS     "; V
4020 PRINT "PRESENT CUTOFF VOLTAGE IS", C
4030 PRINT "DO YOU WANT TO SPECIFY A NEW "
4040 PRINT "   V - VOLTAGE CUTOFF"
4050 PRINT "   P - PERCENTAGE CUTOFF"
4060 PRINT "   L - LEAVE AS IS? "
4070 A$=INKEY$ : IF A$="" THEN 4070
4080 IF A$="V" THEN 4120
4090 IF A$="P" THEN 4150
4100 IF A$="L" THEN 4200
4110 GOTO 4030
4120 INPUT "ENTER VOLTAGE"; C
4130 IF C<=0 OR C>17 THEN 4120
4140 GOTO 4200
4150 INPUT "ENTER NOMINAL VOLTAGE"; C
4160 IF C<=0 OR C>16 THEN 4150
4170 INPUT "ENTER PERCENTAGE AT WHICH TO CUT"; P
4180 IF P<=0 OR P>100 THEN 4170
4190 C=C*P/100
4200 PRINT "NEW CUTOFF WILL BE AT "; C
4210 RETURN

4500 'READ VOLTAGE

4510 V = JOYSTK(0) * K
4520 V = INT (V*100 + .5) / 100
4530 RETURN
```

Program listing.

program is running to get the menu, but if you remember the commands you need not get the menu—you can just type the required single-letter command at any time.

Load, No Load. These two commands simply operate the load relay. Each time you do so, the corresponding time will be displayed on the screen or printer.

Printing. P will give you a new menu:

PRINT MENU
P—PRESENT DATA
D—SAVED DATA
G—GRAPH SAVED DATA
ANYTHING ELSE—QUIT

All of these commands require a printer. C prints the current time and battery voltage; D and G print and graph, respectively, saved data (more on this later).

Start Test. This is the command which starts the battery test process. Pressing S will give you the following:

STARTING TEST
PRESENT VOLTAGE IS …
PRESENT TIME = 00:00:00
HOW OFTEN DO YOU WANT DATA
(IN MINUTES)?

At this point, you specify how often you want the program to print or display the time and voltage. Then the program continues with

```
PRESENT MEASURED VOLTAGE IS...
PRESENT CUTOFF VOLTAGE IS 0
DO YOU WANT TO SPECIFY A NEW
  V—VOLTAGE CUTOFF
  P—PERCENTAGE CUTOFF
  L—LEAVE AS IS?
```

The present measured voltage is the battery voltage as currently measured with no load. The cutoff voltage is the minimum voltage you want the battery to discharge to before disconnecting the load resistor. This value is set in line 110 of the program and presently defaults to 0 volts, but you can change line 110 to default to any other value.

Alternatively, you can specify a new cutoff voltage at this point in one of two ways—as an actual voltage (with the V option) or as a percentage of rated voltage (with the P option). If you choose P, then the program will ask you for the nominal battery voltage and a percentage at which to cut off the load. For example, to discharge a 15-volt battery down to 90% of its rated voltage (i.e., 13.5 volts) you would enter 15 volts and 90 percent.

The final question will be REPORT ON TV OR PRINTER? You can answer with either TV (or just T) or PRINTER (or just P). If you have a printer, then the P option will print the time and voltage on the printer; the T option will display only on the TV screen.

Once you answer this final question, the program closes the load relay and starts to monitor the battery voltage. The top of the screen will display the present data like this:

```
TIME 00:00:00
VOLTAGE 15
LOAD ON
```

The time will increment each second and the battery voltage will be displayed continuously below it. At the same time, the bottom of the screen (and the printer, if you have selected it) will keep track of time and battery voltage. For example, Fig. 5 shows the printed display for a very weak 15-volt, 225-mAh Motorola HT-220 battery.

In addition to displaying or printing the time and voltage, the program also saves these in the T$ (time) and VO (voltage) arrays dimensioned in line 20. The D and G options in the print menu allow us to print or graph this data after the test is completed. The graph routine is set up for a 32-column printer (such as the Radio Shack TP-10), so it is very low resolution; you may want to remove the /2 in line 3270 to get a wider display on better printers. Fig. 6 simulates the graph for the data shown in Fig. 5; the vertical axis is voltage and the horizontal axis is time.

Calculating Battery Capacity

The clock time for the program is derived from the real-time clock of the CoCo as read by the TIMER function. It is quite accurate, although it may lose a few tenths of a second during long printouts. Since the time when the load is disconnected is printed, it is easy to determine how well the battery meets its specifications.

```
NO LOAD VOLTAGE 15.6
LOAD ON AT 00:00:00
LOADED VOLTAGE 12.48
00:01:00                12.48
00:02:00                12.48
00:03:00                12.22
00:04:00                12.22
LOADED VOLTAGE 11.96
LOAD OFF AT 00:04:41
00:05:00                14.82
00:05:00                15.08
```

Fig. 5. Sample program printout.

NiCd battery capacity is rated in mAh (milliampere hours) or Ah (ampere hours), the product of discharge current times discharge time. For example, a 1-Ah battery should last 1 hour at 1 Ampere, 2 hours at 1/2 Ampere, 1/2 hour at 2 Amperes, or 9 hours at 1/9 Ampere. In practice, though, there are two other factors which must also be considered.

First, what do we mean by a battery "lasting"? How low do we let its voltage drop before we give up on it? Most manufacturers let their batteries discharge down to either 1.1 or 1.0 volts per cell in determining cell capacity.

The second factor is the fact that the product of discharge time and discharge current varies with the rate of discharge. For example, a 1-Ah battery which lasts an hour at 1 Ampere load (which is called the "one-hour" discharge) may last slightly more than two hours at 1/2 Ampere, and slightly less than 1/2 hour at 2 Amperes.

Since discharging a battery at a lower current than the one-hour rate produces a larger time x current product, many manufacturers rate their batteries not in terms of a one-hour discharge, but in terms of two or even more hours. This complicates our calculations since we seldom know how any particular battery is supposed to be rated!

Nevertheless, assuming that the battery's mAh or Ah rating is constant results in a fairly small error. In particular, since our 100-Ohm load resistor results in discharge times of two or more hours in most cases, we should expect the product of discharge time and the discharge current to equal or exceed the battery rating—if the battery is in good shape, properly charged, and discharged down to the correct level of 1.0 or 1.1 volts per cell, depending on the manufacturer.

Hence, to calculate the actual capacity of the battery, set the discharge cutoff voltage to 1.0 or 1.1 volts per cell, let the program time the discharge, and then multiply the time in hours (convert minutes into fractions of hours) by the discharge current (which is approximately equal to the rated battery voltage divided by the value of R_L).

The only question is whether we should go down to 1.0 or 1.1 volts per cell. Although 1.0 volts per cell is used by manufacturers, in practice it might be a good idea to stop at 1.1 volts to avoid reverse-charging of weak cells. This will result in a lower apparent battery capacity, but the difference should not be more than about 10%.

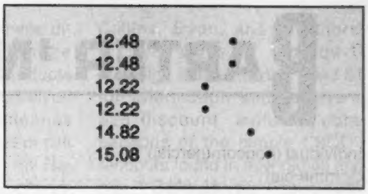

Fig. 6. Plot of data in Fig. 5.

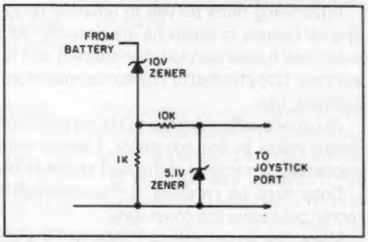

Fig. 7. Scale Expander Circuit.

Improvements

You can probably think of many ways of improving the circuit or program, but I have found it quite satisfactory for my purposes. Nevertheless, the circuit does have one disadvantage—the limited accuracy in measuring battery voltage caused by the limited resolution of the A/D converter. Although we could build a better A/D circuit, there is a much easier way of improving the resolution by a factor of two or three, and that is by expanding the scale. This involves a fairly simple change to the voltage-divider circuit as shown in Fig. 7.

In this circuit, the 10-volt zener does not conduct until the input voltage rises above 10 volts, and so the A/D converter indicates 0 output for any voltage below 10 volts. Once the battery voltage exceeds 10 volts, however, the diode subtracts 10 volts from the input and the A/D gets the battery voltage minus 10 volts. Hence, a 14-volt battery, for instance, sends only 4 volts to the A/D converter.

Now, instead of the A/D converter having to cover the entire range from 0 to 15 volts in its 63 steps, it has only to cover the range from 10 volts to 15 volts. Since it divides the range into 64 steps, the error is now just 5/64, or just about 0.8 volts. Note, though, that making such a change requires that the program also be changed to compute the actual voltage with a slightly different formula. Depending on the characteristics of the 10-volt zener diode, some additional program changes may be required to compensate for non-linearities in the voltage readout.

Conclusion

The circuit and program described here are handy applications of a small, inexpensive computer toward a very useful job. They provide a simple and cheap solution (assuming you already have the computer) to a problem which would require a fairly complex and expensive circuit if you wanted to do the same thing some other way. ■

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HAMFEST Sunday, September 21, 1986. LIMARC sponsors the ARRL Long Island Hamfair at the New York Institute of Technology, Route 25A/Northern Blvd., Old Westbury NY. Outdoor tailgating, no reservations needed. Sellers' car space $5, general admission $3. Wives, children, and sweethearts free. All hams must buy a ticket! Exit 39 North, Rte. 495, north on Glen Cove Road, two miles to 25A, turn right one mile to site. Talk-in on 146.85. Food and refreshments available and many awards to attendees. Open 7:30 a.m. for sellers, 9 a.m. for buyers. If further info is needed, call the LIMARC info hot line at (516)-796-2366 or Hank Wener WB2ALW at night at (516)-484-4322. BNB465

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SPECIAL EVENTS

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received by 73 Magazine by the first of the month, two months prior to the month in which the event takes place. Mail to Editorial offices, 73 Magazine, WGE Center, Peterborough, NH 03458-1194.

LABOR DAY TRAVEL
AUG 30–SEP 1

The Tri-City ARC will operate special-event station KA1BB from the Waterford, Connecticut, I-95 weigh station to promote safe Labor Day holiday auto travel. This event is in conjunction with the fourth annual Stay-Awake Coffee Stop offered by BSA Troop 24 of Niantic, Connecticut. Mobile operators are especially encouraged to call. Operation will be from 1700 UTC August 30 through 2300 UTC September 1 on 14.295, 7.245, and 3.395 phone and on 7.130 CW. Talk-in on 146.52 and CB channel 19. QSL via Tri-City ARC, PO Box 686, Groton CT 06340. For further information, please contact Bob Dargel KA1BB, 8 Willow Lane, East Lyme CT 06333; (203)-739-8016 or (203)-446-7325 (work).

OK CORRAL
AUG 30–SEP 1

The Old Pueblo RC will operate special-event station W7GV from 1300 UTC August 30 to 2200 UTC September 1, from the famous OK Corral at Tombstone, Arizona, site of the famous shoot-out between the Earps and Clantons in 1881, in celebration of the Rendezvous of the Gunfighters. Frequencies: SSB—21.380, 14.280, 7.280, and 3.980; CW—14.060, 7.130, and 3.730. Send a QSL with an 8-1/2 x 11 envelope and 40 cents postage to W7GV, PO Box 42601, Tucson AZ 85733.

PLYMOUTH FALL FESTIVAL
SEP 4–7

The Stu Rockafellow ARS will operate station W8NJH on September 4–7 to celebrate its 25th anniversary, in conjunction with the Plymouth, Michigan, fall festival. Frequencies: phone—10 kHz from the lower end of the General-class bands; CW—center of the Novice bands. Certificate will be issued for QSL and SASE. QSL via W8NJH or WD8IAE.

WINDSOR ME
SEP 6

The Augusta Emergency Amateur Radio Unit will sponsor the Windsor Hamfest on September 6 at the Windsor, Maine, Fairgrounds. Gate donation is $1, camping $3 per night or $5 for two nights. Talk-in on 146.22/.82. For further information, contact Dot W1TGY and Phil Young W1JTH, 47 Longwood Avenue, Augusta ME 04330; (207)-622-1385.

UNIONTOWN PA
SEP 6

The Uniontown ARC (W3PIE) will hold its 37th annual Gabfest on September 6 on the club grounds, located on the Old Pittsburgh Road just off Rte. 51 and the 119 bypass in Uniontown, Pennsylvania, 50 miles south of Pittsburgh. $3 registration or two for $5. Free swap-and-shop setup with registration. Talk-in on 147.645/.045 and 144.57/.17. For further information, contact UARC Gabfest Committee, c/o John T. Cermak WB3DOD, 36 Steel Street, PO Box 433, Republic PA 15475; (412)-246-2870.

COACH PAUL "BEAR" BRYANT DAY
SEP 6

The West Alabama ARS of Tuscaloosa, Alabama, will operate special-event station WD4DAT on September 6 from 1300–2300 UTC, in honor of college football and coach Paul "Bear" Bryant. The station will operate on the lower 25 kHz of the General 80-, 40-, 20-, and 15-meter bands. For an 8-1/2 x 11 commemorative certificate, send your QSL and an SASE to WAARS Special Event, PO Box 1741, Tuscaloosa AL 35403, or to the callbook address of WD4DAT.

POPCORN FESTIVAL
SEP 6

The Porter County ARC will operate special-event station N9RD on September 6, from 1500–2300 UTC, to celebrate the annual Orville Redenbacker Popcorn Festival. Suggested frequencies:

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WHIPPANY AT&T 30TH
SEP 6

AT&T Bell Labs Whippany ARC will operate station W2TW on September 6 from 1300–2200 UTC to commemorate its 30th anniversary. Operation will be in the lower portions of the 10–80-meter General phone bands. A 2-meter station will operate 147.63/147.03 (W2TW) and 144.210. For a QSL, send an SASE and QSL to Rick Anderson WB2QOQ, 243 Mountain Avenue, Murray Hill NJ 07974.

NIAGARA FALLS NY
SEP 6

The Ham-O-Rama and Computerfest '86 will be held on September 6, from 7 a.m. to 5 p.m., at the Niagara Falls International Convention Center in Niagara Falls, New York. Registration is $3.50 in advance (before August 20) or $5 at the gate. Tailgating $5; $5 per 4-foot flea-market table, $7 after August 20. Exams given. Talk-in on 146.31/.91 (W2EUP) and 146.52. For more information, contact Nelson Oldfield W2ZSJ, 126 Greenaway Blvd., Cheektowaga NY 14225.

CHATTANOOGA TN
SEP 6–7

The 8th annual Hamfest Chattanooga Amateur Radio and Computer Convention will be held September 6–7 at the South Hall of the new Convention and Trade Center. 8-foot flea-market tables are $6 for one day or $10 for both days (electrical power is $10 extra). Exams given both days. Talk-in on 146.19/.79. For additional information, write to Hamfest Chattanooga, PO Box 3377, Chattanooga TN 37404, or call Nita Morgan N4DON at (404)-820-2065 (for dealer exhibitors) or Barbara Gregory WA4RMC at (615)-892-8889 (for flea market).

62ND ANNIVERSARY FAIR
SEP 6–7

The Hen House Gang ARC of Bethlehem, Connecticut, will operate station W1FHP on September 6–7 during daylight hours. Frequencies will be the 10-, 15-, 20-, and 40-meter bands, SSB plus Novice CW. For a QSL, send a first-class stamp and an address label if you have one (no envelopes) to W1FHP.

MELBOURNE FL
SEP 6–7

The Platinum Coast ARS will sponsor its 21st annual Melbourne Hamfest on September 6–7 at the Melbourne Auditorium just off U.S. 1 in downtown Melbourne, Florida. Hours are 9–5 Saturday and 9–4 Sunday. Admission is $3 in advance, $4 at the door. Table reservations limited to two adjacent tables. Exams given. Talk-in on 146.25/.85. For more information, send an SASE to PCARS, PO Box 1004, Melbourne FL 32901. Mark the envelope "Tables" for table reservations or "Exams" for exam information.

BATTLE OF LAKE ERIE
SEP 6–7

The Radio Association of Erie, Pennsylvania, will operate station W3GV, from 9 a.m. to 9 p.m. on September 6 and from 9 a.m. to 5 p.m. on September 7, to commemorate Commodore Oliver Hazzard Perry's victory at the Battle of Lake Erie during the War of 1812. Frequencies will be 7.235 and 14.235 phone; 7.090 and 14.090 CW/RTTY. Special QSL via W3GV, PO Box 844, Erie PA 16512, or W3 QSL Bureau for DX stations. Include a business-size SASE.

NORWALK CT
SEP 7

The Fairfield, Norwalk, Stamford, and West Haven ARAs will sponsor the Fairfield County Hamfest on September 7, from 9 a.m. to 5 p.m., at the Norwalk National Guard Armory, immediately off Exit 38 Merritt Parkway. Admission is $3, tailgating $5, tables $10, power free. Talk-in on 147.39/.99 and 146.52. For early registration, write to PO Box 326, West Haven CT 06516.

LA PORTE IN
SEP 7

The La Porte and Michigan City ARCs will hold their combined Summer Hamfest on September 7 at the La Porte County Fairgrounds, located on State Road 2 on the West Side of La Porte, Indiana. Inside tables $3, paved selling area outside. Talk-in on 146.52.

BUTLER PA
SEP 7

The Butler County ARA will sponsor the Butler Hamfest on September 7, from 9 a.m. to 4 p.m., at the Butler Farm Show Grounds at Roe Airport in Butler, Pennsylvania. Mobile check-ins until noon on 147.96/.36. Directions on 147.84/.24. $1 admission, children under 12 free. Free outdoor flea market. Indoor flea market, $5 per 8-foot table. For more information, contact John K3HJH, 174 Oak Hills Heights, Butler PA 16001; (412)-283-9403.

MISS AMERICA PAGEANT WEEK
SEP 7–14

The Southern Counties ARA will operate special-event station K2BR during the week of September 7–14, from the Miss America Pageant in Atlantic City, New Jersey. Frequencies: phone—the lower 25 kHz of the General-class band; CW—the lower 65 kHz; 7.125 and 21.150 in the Novice band. For a QSL send your QSL and an SASE to SCARA, Box 121, Linwood NJ 08221.

LOS ALTOS HILLS CA
SEP 13

The Foothills ARS will hold a flea market on September 13 from 8 a.m. to 2 p.m. at the Foothill Junior College, I-280 and El Monte Road, Los Altos Hills, California, parking lot "B." Sellers $7, others free. Sellers get two parking spaces. Talk-in on 145.27/144.67. Exams given 12 noon. For information, call (408)-255-9000.

ROBINSON 100TH
SEP 13–14

The Crawford County ARC will operate its club station WA9ISV on September 13 and 14 from 9 a.m. to 6 p.m. EDT to commemorate the centennial of Robinson, Illinois. Operation will be on the following frequencies: 7.250, 14.250, and 21.350 ± QRM. Local-area hams may use 147.96/.36. For a certificate, send QSL and 9-1/4 x 14-1/4 SASE to CCARC, or for more information, contact Ray Everly WB9SVH, 310 E. Magnolia Street, Robinson IL 62454; (618)-544-3709.

ARBORETUM DAYS
SEP 13–14

The Great River ARC will operate special-event stations W0LBR and WB0QMA from the Dubuque, Iowa, Arboretum on September 13–14, from 1500–2100 UTC, to celebrate Dubuque Riverfest and Arboretum Days. Frequency for station W0LBR will be 7.115 ±5 kHz in the Novice band. Frequency for station WB0QMA will be the lower 20 kHz of the General-class band. QSL to Cliff Stanton W0LBR, 1260 Madera Street, Dubuque IA 52001 or to Gene Chapel WB0QMA, 1795 Hale Street, Dubuque IA 52001.

JACK LONDON STATE PARK
SEP 13–14, 20–21

The Valley of the Moon ARC will operate special-event station N6KM on September 13–14 and 20–21 from 8 a.m. Saturday to 6 p.m. Sunday. The station will operate from the Wolf House in Jack London State Park in Glen Ellen, California, to commemorate the author. Operation will be in the General phone band on 21.360, 14.275, and 7.225, ± depending on QRM. For an 8-1/2 by 11 commemorative certificate, send QSL, SASE, and $1 to VOMARC, 358 Patten Street, Sonoma CA 95476.

MT. CLEMENS MI
SEP 14

The L'Anse Creuse ARC will present its 14th annual Swap and Shop on September 14 from 8 a.m. to 3 p.m. at the L'Anse Creuse High School in Mt. Clemens, Michigan. Admission is $1 in advance, $3 at the door. Trunk sales, $4 per space; inside tables, $8 each. Talk-in on 147.69/.09 and 146.52. For tickets and table reservation, contact Maurice Schietecatte N8CEO, 15835 Touraine Ct., Mt. Clemens MI 48044; (313)-286-1843. Include an SASE.

CORONA NY
SEP 14

The Hall of Science ARC will hold a hamfest on September 14 (rain date Sept. 28), beginning at 9 a.m., at the Hall of Science Bldg., 111th Street and 48th Avenue, Corona, New York. For information and reservations, call John Powers KA2AHJ at (718)-847-8007 in the evenings.

CARTERVILLE IL
SEP 14

The Shawnee ARC will hold its annual hamfest on September 14, beginning at 7 a.m., at John A. Logan College Gym on Hwy. 13 near Carterville, Illinois, nine miles east of Carbondale, Illinois. Admission is $3. Exams given Sunday morning. Talk-in on 146.25/.85, 146.52, and 3.925 (8–9 a.m.). For more information, contact Shawnee Radio Association, 502 West Kenicott, Carbondale IL 62901; (618)-457-7586.

DANBURY CT
SEP 14

The Candlewood ARC will hold

its annual hamfest and flea market on Sep. 14, from 9 a.m. to 3 p.m., at the Danbury Elk's Club, 346 Main St., Danbury CT. Admission is $2, kids under 12 free. Tables are $8, including one admission. Tailgaters $5. Talk-in on 147.72/.12. For more information, contact Gene Marino W1IDH, 27 Valley View Road, Newtown CT 06470; (203)-426-8852.

FARGO ND
SEP 19–21

The Red River Radio Amateurs will sponsor the Dakota Division Convention on September 19–21 at the Holiday Inn, I-29 and 13th Avenue South, Fargo, North Dakota. Registration begins at 4 p.m. on Friday. Admission is $7. $5 per table for indoor flea market. Preregistered exams given. Talk-in on 146.76. For more information, send an SASE to The Red River Radio Amateurs, Box 3215, Fargo ND 58108-3215, or call W0LHS evenings at (701)-232-0310.

BARRIE ONT
SEP 20

The Hex-9 Group of the Barrie ARC will hold its 2nd Packet Radio Symposium on Sep. 20, with flea market in the a.m. Co-sponsored by and held at Georgian College, Barrie, Ontario. Admission is $5. Talk-in on 146.25/.85. For more information, contact Hex-9 Group, Box 151, Orillia, Ontario, Canada L3V 6J3.

SEBASTOPOL CA
SEP 20

The Sonoma County Radio Amateurs will hold its fourth annual Ham Radio flea market on September 20, from 8 a.m. to 2 p.m., at the Sebastopol Community Center, 390 Morris Street, Sebastopol, California, five miles west of Santa Rosa, just off Hwy. 12. Tables are $7 at the door or $5 in advance. VEC exams. Talk-in on 146.13/.73. For tickets and information, write SCRA, Box 116, Santa Rosa CA 95402.

MAPLE SHADE NJ
SEP 20

The Maple Shade ARC will sponsor its first annual hamfest on Sep. 20, from 8 a.m. to 2 p.m., at the Maple Shade High School, Coles Avenue, in Maple Shade, New Jersey. A $5 donation per carload includes one tailgate space. Talk-in on 223.02/224.62 and 146.52. For more information, contact Howard Weinstein K3HW, 15 Lakeside Drive, Marlton NJ 08053; (609)-596-3304.

PEORIA IL
SEP 20–21

The Peoria Area ARC will hold the Peoria Superfest '86 hamfest on September 20 and 21 at the Exposition Gardens, W. Northmoor Road, Peoria, Illinois. Gate opens at 6 a.m., Commercial Building at 9 a.m. Admission is $3 in advance, $4 at the gate. Children under 16 are free. Talk-in: call W9UVI on 146.16/.76. Exams given both days. For more information and reservations, send an SASE to Superfest '86, PO Box 3461, Peoria IL 61614.

YORK PA
SEP 20–21

The York ARC, Keystone VHF Club, Penn-Mar RC, and Hilltop Transmitting Assn. will hold the York Hamfest on September 20–21 at the York Fairgrounds, State Rte. 74, in the northeast corner of the city. Registration is $3 each day or $5 for both days. Women and children under 12 free. Tailgating $4 per day or $6 for both days. Registration begins at 8 a.m. Tables $5 and up. Exams on Saturday. Write to York Hamfest, Box W, Dover PA 17315 for reservations and additional details.

AUGUSTA GA
SEP 21

The ARC of Augusta, Georgia, will hold its annual hamfest on September 21 at Julian Smith Casino. Inside dealer tables $10. Ample room for tailgaters. Exams at 8 a.m. in the Red Cross Building, 12th Street. Talk-in on .34/.94. For additional information, send an SASE to Charles Pennington K4FRM, 4542 Glenda Lane, Evans GA 30809, or call (404)-868-8842 after 6 p.m.

NEW KENSINGTON PA
SEP 21

The Skyview Radio Society will hold its 1986 Swap and Shop Hamfest on September 21, at the club grounds on Turkey Ridge Road, New Kensington, Pennsylvania. Talk-in on 146.64/.04. For further information, call Scott Rupert N3DDZ at (412)-478-3488.

WILLIMANTIC CT
SEP 21

The Natchaug ARA will hold its 4th annual Giant Flea Market on September 21 beginning at 9 a.m. at the Elks Home, 198 Pleasant Street, Willimantic, Connecticut. Admission is $2, children under 16 free. Advance reserved tables inside $5 each, $7 at the door. Tailgaters welcome. Outside space $5 and up. Exams given. Talk-in on 147.30/.90 and .52. For more information, please contact Ed Sadeski KA1HR, 49 Circle Drive, Mansfield Center CT 06250; (203)-456-7029 (after 4 p.m.).

WESTBURY NY
SEP 21

The LIMARC will sponsor the ARRL Long Island Hamfair on September 21, beginning at 9 a.m., at the New York Institute of Technology, Rte. 25A Northern Blvd., Old Westbury, New York. Admission for hams is $3, others free. Seller's car space, $5. Outdoor tailgating, no reservations needed. Talk-in on 146.85. For further information, call Hank Wener WB2ALW at night at (516)-484-4322.

ADRIAN MI
SEP 21

The Adrian ARC will hold its 14th annual hamfest on September 21, from 8 a.m. to 3 p.m., at the Lenawee Fairgrounds in Adrian, Michigan. Advance tickets $2, $3 at the gate. Full table $6, half table $4, trunk sales $2. Talk-in on 146.310/.910 or 449.675. For information or reservations, write Adrian ARC, PO Box 26, Adrian MI 49221.

CHICAGO CLUB 60TH
SEP 21

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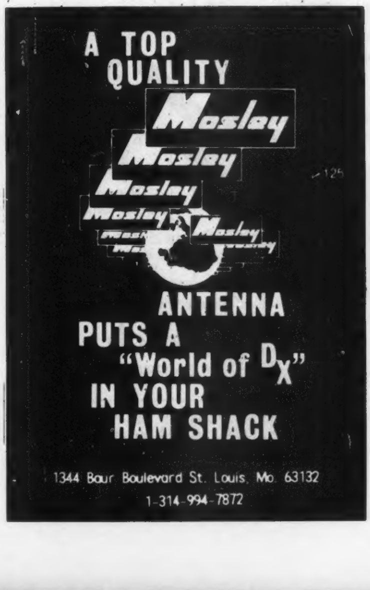

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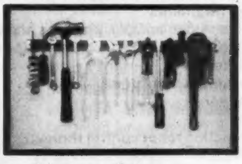

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SIERRA VISTA AZ
SEP 27

The Cochise ARA will hold a flea market on September 27 at the CARA Training Facility on Moson Road near Sierra Vista. For more information, write CARA, PO Box 1855, Sierra Vista AZ 85636.

SANTA FE NM
SEP 27–28

The Northern New Mexico ARC will hold its third annual hamfest on September 27 and 28 at Camp Stoney, eight miles east of Santa Fe, New Mexico. Exams will be given on Saturday; there will be a tailgate flea market on Sunday. Registration is $5 for adults, $2 for children under 12. Talk-in on 146.22/.82 or 146.52. For further information, send an SASE to Alan Hill N5BGC, 2020 Calle Perdiz, Santa Fe NM 87505.

ELMIRA NY
SEP 27

The Elmira Amateur Radio Association will present its 11th annual Elmira International Hamfest on September 27, from 6 a.m. to 5 p.m., at the Chemung County Fairgrounds. Tickets are available at the gate or in advance from Steve Zolkosky, 118 East 8th Street, Elmira Heights NY 14903.

GRAYSLAKE IL
SEP 27–28

The Chicago FM Club will hold Radio Expo 86 on September 27–28 at the Lake County Fairgrounds, Routes 120 and 45, in Grayslake, Illinois. Flea market opens at 6 a.m. and exhibits at 9 a.m. Tickets $4 in advance, $5 at the gate. Indoor flea-market tables $7.50 per day, reservations by September 10. Exams given. Talk-in on 146.16/.76. For more information, send an SASE to Radio Expo 86, Box 1532, Evanston IL 60204, or call (312)-582-6923.

HARVESTER MO
SEP 28

The St. Peters ARC will hold its second annual swapfest on September 28 at the Harvester Lions Club Park, Harvester, Missouri, about six miles south of St. Charles. $1 admission. Talk-in on 145.33. For more information, contact Joe Riordan KG0K, 2760 Hwy. 40-61, O'Fallon MO 63366.

GAINESVILLE GA
SEP 28

The Lanierland ARC will hold its Hamfest '86 on September 28 at the Holiday Inn in Gainesville, Georgia, from 8:30 a.m. to 3:30 p.m. Free admission. Exams given. Talk-in on 146.67/.07. For more information, write to George D. Floyd, Rte. 11, Box 661A, Gainesville GA 30501.

WELLESLEY MA
SEP 28

The Wellesley ARS will hold its annual outdoor flea market on September 28, from 9 a.m. to 2 p.m., in the parking lot of the Wellesley Senior High School, Rice Street, Wellesley, Massachusetts. Admission is $1 for buyers, $2 for sellers. Talk-in on 147.63/.03.

WATERBURY CT
SEP 28

The Waterbury (CT) ARC will sponsor a flea market on September 28, from 10 a.m. to 3 p.m., at the Waterbury State Technical College off I-84 in Waterbury, Connecticut. Admission is $2. Indoor spaces will be $10/table, tailgating $5. Dealers and sellers should contact Gary Firtick K1EB, 589 Hamilton Avenue, Watertown CT 06795, by September 15.

BOARDMAN OCTOBERFEST
SEP 28

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USING THE AO-10 PREDICTIONS

Apogee predictions for the month of September are provided for three sections of the United States: Washington, D.C.; Denver, Colorado; and Los Angeles, California. Times are in UTC and apogee in this case is mean anomaly 128 rounded to the nearest whole hour. Use the chart as a guide in aiming your antenna, then fine-tune the azimuth and elevation values to peak the satellite's beacon signal. If you require more accurate orbital predictions, contact AMSAT at PO Box 27, Washington DC 20044.

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September 1986

		WASH		DENVER		LA	
DAY	TIME	AZ	EL	AZ	EL	AZ	EL
1	0830	185	27	154	22	139	20
2	0749	174	27	144	18	131	15
3	0708	163	26	136	13	124	8
4	0627	153	23	128	8	118	2
5	0546	144	19	121	2		
6	0505	135	14				
7	0424	128	8				
8	0343	121	2				
9	1442					242	6
10	1401					235	10
11	1320			237	5	228	17
12	1239			230	11	220	23
13	1158			222	16	211	28
14	1117	237	5	213	21	200	31
15	1036	230	12	203	25	189	34
16	0955	222	17	193	27	177	34
17	0914	213	22	182	28	165	33
18	0833	203	26	170	28	154	30
19	0752	193	28	159	26	144	26
20	0712	181	29	149	23	135	20
21	0631	170	29	140	18	127	14
22	0550	159	27	132	13	120	8
23	0509	149	24	124	7	114	1
24	0428	139	19	117	1		
25	0347	131	14				
26	0306	124	8				
27	0225	117	1				
28	1324					241	7
29	1243			243	2	235	14
30	1202			236	8	227	21

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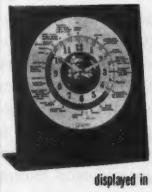

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ABOVE AND BEYOND

Peter H. Putnam KT2B
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Antennas, antennas! If there's a subject that holds more fascination for amateurs, I have yet to hear of it. Everybody's got a favorite design, or configuration, or manufacturer. Horizontal polarization, vertical polarization, circular polarization, yagis, quagis, loops, J-poles, whips, phased arrays, stacked arrays . . . you could go on forever.

Certainly no topic arouses more controversy either, as one person's "tried-and-true" design is quickly debunked by others. There are those who do it all by the book, and there are those who burned their books a long time ago!

I'm going to touch on some assorted topics pertaining to VHF and UHF antennas that I think are relevant (based on conversations, correspondence, and other communications throughout the past year).

Gain . . .

Now there's a truly abused term. There are many types of gain—dB, dBi, forward, etc. *QST* has determined that gain measurements can be so misleading that they won't publish them in advertisements. It's not a bad idea—after all, when was the last time you saw an isotropic dipole?

How can you really measure the gain of your antenna array? I detailed a method using formulae from MIT some months back, but this is more useful at microwave frequencies since the distance between the two antennas under test must be 100 wavelengths (at 144 MHz, that's roughly 650 feet. Not too practical!).

The accepted way is to use calibrated test equipment and establish a standard for that particular test (or round of tests). One way might be to employ a simple dipole as a receiving antenna, fixed to a tripod. A low-level signal source is placed a certain distance away. This known source of energy is recorded at its source (such as another dipole or simple whip) and an rf millivoltmeter is used to record the output from the dipole. This number doesn't mean anything really; it's just a number to reference to.

Say the number is +3 dBm. This is logged, and the test dipole is replaced with the desired array, taking care to maintain the same distance from the signal source. The output of the source is checked for accuracy, and after alignment for peak signal readings, the rf millivoltmeter is again checked. In this hypothetical case, let's say the reading might be +9 dBm. So, what does it mean?

It means that your test antenna has a gain of 6 dB over the reference antenna. That's it, and nothing more! Of course, this could be influenced by any number of things, such as atmospheric moisture content (especially at UHF), interaction of nearby conductive objects, and even the stability and accuracy of the test signal source and the rf millivoltmeter! It's easy to see why so much controversy erupts over figures of gain. About the only thing you can do with some confidence is to measure comparable antennas from different manufacturers to see how they compare to each other, and this is exactly what happens at an antenna measuring contest. But you must have accurate, stable test equipment for the numbers to mean anything.

Assuming you can obtain such equipment, measuring your own and others' antennas (such as long-boom yagis) can be a worthwhile and educational experience, as well as fodder for endless arguments over a beer! In my own tests, I've employed stable low-level signal generators with a Boonton 902 rf millivoltmeter to make such measurements. In one case, I was able to verify within .25 dB a manufacturer's claim for forward gain. However, it required two identical antennas and some careful measurements!

Stacking

Disregarding the column I wrote on stacking a few months ago so unsatisfactorily, let me tackle the subject again. Stacking does provide many benefits, among which is increased forward gain. How much? The rule of thumb would appear to be 3 dB per array, based on pure math. Based on actual experience, it might be more like 2–3 dB per array.

Note that when I say "per array," I mean a geometrically equal array. If you start out with one yagi, adding a second should increase gain by the above figure. Since the process is a square-law function, however, you need to add two more yagis to your existing two yagis to increase gain by another 2–3 dB. Start with four, and you'll need to add another four to see that extra 2–3 dB.

What advantages are to be had? In addition to gain (again, a number meaning nothing unless you reference it to some known value), the capture area of the array, or aperture, increases geometrically. This is especially useful when engaged in extremely weak signal work, such as low-level tropospheric enhancement, scatter, and, of course, moonbounce. However, you may encounter some distortion of the sidelobe pattern, based on any individual yagi in the array.

Despite the fact that this is a geometric process, the horizontal spacing between yagis in an array may not equal the vertical spacing when optimum results are achieved. A classic example of this is the RIW 432-19 yagi, where many users of four-bay RIWs report that vertical spacing is on the order of 5-1/2 feet, but horizontal spacing is about 5 feet.

The angle of radiation will change, and this is more evident on 50- and 144-MHz arrays used in over-the-horizon modes such as Es and tropo. Is there an increase in the front-to-back ratio? In many cases, yes. In some cases, no. It's a grey area, for sure, and only experimentation will yield definitive results. As far as spacing goes, the rule of thumb has been one-half the boom length, for conventional arrays. In the case of some of the "long-boom" antennas seen recently, this number will change.

Your best bet is to consult the manufacturer's literature. I've found the KLM, Cushcraft, and Tonna literature to be quite accurate and helpful in this regard, especially in regards to stacking arrays. You'll also need to make up phasing lines or use power dividers (my favorite), which are not expensive and have typical losses of .05–.08 dB per unit. It goes without saying that your phasing lines and interconnecting cables should be high quality (I use Belden 8214 up to 432 MHz, and 9913 above that), as should your connectors. No sense trying to gain an extra 2.5 dB and losing most of it in a poorly made junction!

Impedance Matching

We can go all over the place on this one. Current matching schemes in use include gamma, T-match, balun, and folded dipole. The first is quite common to users of older Cushcraft antennas. Usually, a stub in series with a capacitor is used to make the connection to the driven element. This type of match is typically used with coaxial lines, and is somewhat of an effective match. In my experiments in the past, I've noticed a somewhat narrowband characteristic of this type of match.

T-matches are commonly employed by many manufacturers, among them Cushcraft and RIW. Here, two stubs either side of the center of the driven element are adjusted for best match. The common method is to screw these adjustments tight. RIW goes one step further and solders them directly, resulting in a somewhat corrosion-proof connection. T-match systems are more broadbanded than a gamma match.

Baluns are the method employed by KLM. Two types are used: coaxial and sleeve. The coaxial balun is no stranger to the HF operator, and the principle is the same at VHF, only low-loss Teflon™ cable is used for the connection. Coaxial baluns can suck up moisture over a period of time but are fairly reliable and provide a moderately broadbanded match. Sleeve baluns are in effect a section of transmission line and work the same way, but must be installed carefully to avoid moisture accumulation over a period of time. KLM usually provides drain holes in their baluns for this purpose.

The folded dipole provides a very good match. It's broadbanded and usually made from a loop of solid wire, so moisture isn't a problem. The connections can be soldered or screwed on. KLM uses folded dipoles on their 4-element, 144-MHz yagis, but by far the biggest user is Tonna Antennas, who employ them at 432 and 1296 MHz. This type of match is my own favorite at 144 MHz and above, since it is so simple and reliable.

One other type of match is the full-wave loop, used in loop yagis or quagis (quad loops). Loop yagis are very popular at 1296 and above, as the phenomenon of water droplets hanging from conventional dipole-type elements degrades yagi performance. With a loop element, the water runs down to the mounting bracket for the element, out of harm's way.

With vertical antennas, the principles are the same. Instead of a gamma "clip" and tuning stub, we have a tuned coil with tap feeding the driven element—basically the same thing. The difference is that a vertical antenna is an unbalanced system, feeding a radiator against ground, whereas a yagi's driven element is balanced, using a dipole.

Some Weird Designs...

I've heard of some good ones. Back many years ago, one of my high school pals used a longwire with splendid results on 2 meters. Yep, it's possible and it works! Consider that a 60-foot longwire is almost ten wavelengths long and will have gain off the far end. In a pinch, you can use it.

Ground planes made from coathanger wire have got to be the favorite of any apartment dweller, college student, or operator short on cash. Here's how it's done: Cut four lengths of wire 19 inches long. Cut a fifth about 20 inches long and bend a loop in one end so the actual length is still 19 inches. Now grab hold of an old SO-239 chassis connector (or type-N female) and solder the loop piece to the center pin.

Obtain four solder or crimp lugs the same size as the coathanger wire. Bare about 1/4" with a file or sandpaper on one end of each wire and attach to the crimp lugs. Now fasten them securely to the four holes in the S0-239. Attach a piece of coax to the connector and run it to your rig. You can hang the loop wire from a string or other noninductive material out of harm's way. By the way, with the ground-plane elements at 90 degrees to the center whip, the impedance is about 37 Ohms, or a 1.5:1 mismatch. If you want to get closer to 50 Ohms, bend the ground-plane elements down to about 45 degrees, and you'll be there.

Want to obtain some gain in most directions without using a rotor? You can do it with four small yagis (such as KLM or Cushcraft 4-element, 144-MHz beams) mounted around a pipe, and a surplus Transco-type relay of the 4-pole, single-throw type. Then you need but one coax feedline to the shack and a five-wire control cable for the selector box. Presto! The world's fastest antenna rotor.

Want to build it cheap? Make a quagi! It's nothing more than a yagi with full-wave loop elements instead of dipole types. And, of course, a full-wave loop is easily matched—you drive it directly. One friend used such an antenna with four elements off his apartment balcony for several years with excellent results. It was made from soft-drawn aluminum wire and a PVC boom. Best of all, you obtain polarization in both horizontal and vertical planes, making it a versatile all-around beam.

How about using a circularly polarization antenna for terrestrial work? Why not? Another ham I know did this for years with outstanding results. In fact, he never worked the satellites at all, just Es and tropo and aurora (lots of it, too!) with a KLM 144-14C. He operated under the theory that over a long enough distance, both horizontally and vertically polarized waves degrade to a somewhat circularly polarized wave. It must have worked, for with 100 Watts and the KLM he worked some mighty fine DX throughout the South and Midwest!

I'll close with my personal favorite vertical antenna: the J-pole. Imagine the gamma match described earlier feeding a dipole-driven element. Now take that same stub and half the dipole, mount them vertically, feed with coax, and use the same sliding-stub technique to make a match. Presto! An antenna you can put just about anywhere—under an eave, against the house, in a closet, on top of your tower (or on the side), on a fence, even on your car! The J-pole is simplicity personified. It's cheap to buy or make and is very durable, not to mention being the ideal apartment or condo antenna for 50, 144, 220, and 432 MHz!

That's it for this month. Let's hear from you about your favorite antenna systems or schemes! Send along some photos if you can. Soon I'll try to touch on useful test equipment you can pick up cheaply that will come in handy around the shack, and give some observations on the 1986 CQ WW VHF WPX. Until then, see you Above and Beyond!■

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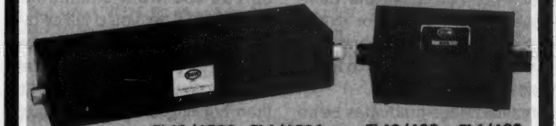

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NEVER SAY DIE

from page 12

know diddley about computers. Oh, I knew the microcomputer just had to develop into a huge industry, but I didn't know how the fool thing worked or how to use it. So I set about learning computers. It wasn't long before I found I was becoming the teacher instead of the student. I kept at it and found my audiences growing. Along the way I was able to start and run some very successful computer magazines.

Amateur radio can be a key to success—if you'll let it. Persistence in radio means education. I hope you find it as exciting and as much fun learning as I do. It isn't work in its bad connotation. How much amateur radio do you know well enough to teach? Can you get up in front of your club and talk about OSCAR operating? How about packet? Slow scan?

There has been a need for years for a practical slow-scan unit for business. We've had the technology for this for well over ten years, yet I've just recently seen a practical unit marketed. Ham historians can go back through my editorials and see where I've suggested such a product several times.

With so few engineers coming out of our schools these days, there are all sorts of opportunities for sharp technicians. Sam Harris W1FZJ wasn't an engineer, but he used his amateur radio experience to become a world expert in microwaves. He's the chap who invented the first parametric amplifier and helped make Microwave Associates what they are today—Ma/com—the outfit giving the satellite business the shaft these days with their scrambling decoders.

Sam built the first parametric amplifier on six meters and I published the first article on it! Readers thought it must be an April Fool article, it was so implausible. His amateur radio work got Sam a nice spot with the big dish in Arecibo. Unfortunately, Sam smoked, so he's no longer with us. So did his wonderful wife, Helen W1HOY . . . gone too. We sure miss pioneers like Sam . . . not many left.

Call it education . . . call it doing your homework . . . it's one major separation between failures and successes. You have the best shot at getting to the big money when you start your own business, but the odds aren't very attractive. This is more because too many entrepreneurs start their businesses without doing their homework and find it's too late to learn all the things they should have known. 90% of all small businesses fail in the first five years. But darned few fail where the homework has been done.

One of these days I may be able to get schools to provide a practical business education. Did you see Rodney Dangerfield in "Back To School"? It was a fun picture, with one great bit where a pedantic college business professor is trying to teach the kids the theory of how to start a business. Dangerfield, a self-made millionaire, who has decided to get a college education and is starting in as a freshman, then points out many of the practical things you have to know to succeed, none of which have much to do with business theory. Great scene.

My advice to anyone interested in making it big with his own business is first to learn the pitfalls while working for someone else. It's dumb to learn with your own money . . . you'll run out . . . as 90% do. Heck, I worked for five years as editor of *CQ* before starting my own magazine. I'd probably still be making the publisher rich if he hadn't fired me. And he was doing very well indeed, by the way . . . pretty much retired on a big yacht. We didn't see him much. In today's dollarettes I'd estimate *CQ* was making over $1 million profit a year.

With communications starting to get into some serious growth, the need for new products and services is going to be almost unlimited. I believe the next really big technology explosion will be in communications . . . via satellites, fiber optics, cables, and microwaves. Our new-found computer power needs communications.

How many years now have I been pointing out the potential for optical data storage? It's finally beginning to emerge, as much from small firms as the giants. Until we get a re-writable optical storage system, I'd suggest someone work on a combination of optical and magnetic storage . . . the optical for high-density storage . . . perhaps a part of the disk for write-once (WORM) and a magnetic segment for indexing the data.

Getting back to education . . . if there's any real demand for theory articles in *73* I'll start a series. But if you'd rather rag-chew your spare time away, I'll just try to keep *73* fun to read and avoid straining your brain. It's up to you. I'm not talking electronic engineering, I'm just talking about your really understanding the theory you are supposed to know for an Extra-class license . . . and maybe a bit extra on digital circuits so you can cope with your ham rigs and their synthesizers.

Let me ask another question. How many technical magazines are you getting? Is the ARRL *Handbook* your ultimate reference manual?

I have a bone to pick with our schools. It's not a new one. If you've been reading anything much more than ham magazines, you know there's been a series of books published exposing the sad state of education in America. I get upset when I visit colleges and find much of their time is spent in remedial work . . . teaching things the kids should have learned in grammar and high school.

Sure, I think everyone should have an education in the arts . . . literature, art, music . . . maybe even food. I'm old enough so I had classes in all of these way before college. My idea of college is as a place to develop your skills for your business career. Artists can go to an art school . . . such as Pratt Institute. My mother went there and became an excellent artist. Musicians have the Eastman School of Music, for example. Engineers have MIT and RPI. But why should RPI have to teach music? That's ridiculous.

Should college graduates be so ill-equipped for a career that all they can do is drive a cab or empty wastebaskets. Yes, I've had college graduate wastebasket emptiers working for me.

One of my goals is to get colleges to teach not only the career material, but also to provide a practical business education to go with it. Then we'd see engineers who have some basic skills in business so they can grab managerial opportunities when they occur. The engineer who knows little about personnel management, accounting, investment banking, purchasing, marketing, salesmanship, public speaking, and so on, will usually avoid the better career opportunities that present themselves.

Take a subject such as advertising. As an expert in this, I'll let you in on a dirty secret. You'd be astounded at how few advertising professionals have any real background. Many of them are absolute frauds, making up for their lack of education with firmly held opinions. When you consider that virtually every firm needs advertising, it's amazing to me that there are so few courses available. I took an invaluable course at the Advertising Club of New York . . . one of the most valuable courses I've ever taken.

Almost anyone could become an expert in advertising in a few months just by reading a few books and taking a course. I'll bet you could run circles around 50% of the ad agencies in results, too . . . maybe 90%.

It's getting a bit difficult to become a computer expert now, but things are still wide open in most communications fields. I don't think there is a college teaching HF rf circuits anymore. They're teaching digital and microwaves. I'm not sure they're even teaching VHF and UHF circuit design.

Another frontier lies in getting stuff through the twisted pair. They're coming from 300 baud to 1200 . . . with 2400 moving up. But there are some sneaky ways of cramming 9600 baud on the lines. And we're hearing about 56,000! How much do you know about all this? If we can get that stuff through an ordinary phone line, how about putting it through a ham channel?

You've been reading a bit about spread-spectrum communications, but I'll bet you'd fall all over yourself if you were asked to explain it to your ham club. Well? Yes, I know it takes more effort than hoisting a cold 807. Maybe you find it more fun to get woozy with a few beers than to learn things. I've always found understanding something new to be exciting. I'll tell you what, the next time you see me at a hamfest or a club meeting, let's see if you can find a subject I'm unable to handle. I've got plenty of weak points . . . can you find 'em?

Another new technology that is working well for entrepreneurs is compact discs. You've probably read this is the fastest-growing consumer-electronic field in history. I've been visiting CD-only stores around the country. Most of 'em have been started on a shoestring, yet most of them have

THE MOST AFFORDABLE REPEATER

ALSO HAS THE MOST IMPRESSIVE PERFORMANCE FEATURES

(AND GIVES THEM TO YOU AS STANDARD EQUIPMENT!)

BAND	KIT	WIRED
6M, 2M, 220	$630	$880
440	$730	$980

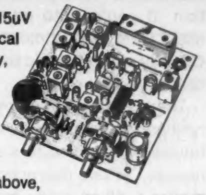
(Also available for commercial bands)

hamtronics
REP100 REPEATER

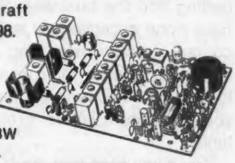
FEATURES:

- SENSITIVITY SECOND TO NONE; 0.15 uV (VHF), 0.2 uV (UHF) TYP.
- SELECTIVITY THAT CAN'T BE BEAT! BOTH 8 POLE XTAL FILTER & CERAMIC FILTER FOR > 100dB AT ± 12KHZ. HELICAL RESONATOR FRONT ENDS TO FIGHT DESENSE & INTERMOD.
- OTHER GREAT RECEIVER FEATURES: FLUTTER-PROOF SQUELCH, AFC TO COMPENSATE FOR OFF-FREQ TRANSMITTERS, SEPARATE LOCAL SPEAKER AMPLIFIER & CONTROL.
- CLEAN, EASY TUNE TRANSMITTER; UP TO 20 WATTS OUT (UP TO 50W WITH OPTIONAL PA).

-HIGH QUALITY XMTR & RCVR MODULES FOR REPEATERS, LINKS, TELEMETRY, ETC.



- **R144/R220 FM RCVRS** for 2M or 220 MHz. 0.15uV sens.; 8 pole xtal filter & ceramic filter in i-f, helical resonator front end for exceptional selectivity, > 100 dB at ± 12 kHz, best available today. Flutter-proof squelch. AFC tracks drifting xmtrs. Xtal oven avail. Kit only $138.
- **R451 FM RCVR** Same but for uhf. Tuned line front end, 0.3 uV sens. Kit only $138.
- **R76 FM RCVR** for 10M, 6M, 2M, or 220. As above, but w/o AFC or hel. res. Kits only $118. Also avail w/4 pole filter, only $98/kit.
- **R110 VHF AM RECEIVER** kit for VHF aircraft or ham bands or Space Shuttle. Only $98.



- **TA51 VHF FM EXCITER** for 10M, 6M, 2M, or 220 MHz. 2 Watts continuous, up to 3W intermittent. Kit only $68
- **TA451 UHF FM EXCITER** 2W cont., up to 3W intermittent. Kits only $68. Xtal oven avail.
- **VHF & UHF LINEAR AMPLIFIERS.** For either FM or or SSB. Power levels from 10 to 45 Watts to go with exciters & xmtg converters. Several models. Kits from $ 78.

NOW—FCC TYPE ACCEPTED TRANSMITTERS, RECEIVERS, AND REPEATERS AVAILABLE FOR HIGH-BAND AND UHF. CALL FOR DETAILS.

RECEIVING CONVERTERS

Models to cover every practical rf & if range to listen to SSB, FM, ATV, etc. NF = 2 dB or less.

RECEIVING CONVERTER

VHF MODELS

Kit with Case $49
Less Case $39
Wired $69

Antenna Input Range	Receiver Output
28-32	144-148
50-52	28-30
50-54	144-148
144-146	28-30
145-147	28-30
144-144.4	27-27.4
146-148	28-30
220-222	28-30
220-224	144-148
222-226	144-148
220-224	50-54
222-224	28-30

UHF MODELS

Kit with Case $59
Less Case $49
Wired $75

Antenna Input Range	Receiver Output
432-434	28-30
435-437	28-30
432-436	144-148
432-436	50-54
439.25	61.25
902-928	422-448

SCANNER CONVERTERS Copy 806 MHz band on any scanner. Wired/tested ONLY $88.

TRANSMIT CONVERTERS

For SSB, CW, ATV, FM, etc. Why pay big bucks for a multi mode rig for each band? Can be linked with receive converters for transceive. 2 Watts output vhf, 1 Watt uhf.

For VHF,
Model XV2
Kit $79
Wired $149
(Specify band)

Exciter Input Range	Antenna Output
28-30	144-146
28-29	145-146
28-30	50-52
27-27.4	144-144.4
28-30	220-222*
50-54	220-224
144-146	50-52
144-146	28-30

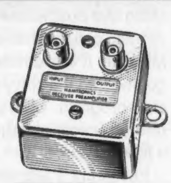
For UHF,
Model XV4
Kit $79
Wired $139

Exciter Input Range	Antenna Output
28-30	432-434
28-30	435-437
61.25	439.25
144-146	432-436*

*Add $20 for 2M input

VHF & UHF LINEAR AMPLIFIERS. Use with above. Power levels from 10 to 45 Watts. Several models, kits from $78.

LOW-NOISE PREAMPS



Hamtronics Breaks the Price Barrier!

*

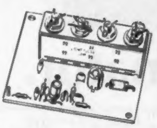
No Need to Pay $80 to $125 for a GaAs FET Preamp.

FEATURES:

- Very Low Nose: 0.7dB VHF, 0.8dB UHF
- High Gain: 13 to 20dB, Depending on Freq.
- Wide Dynamic Range for Overload Resistance
- Latest Dual-gate GaAsFET, Very Stable

MODEL	TUNES RANGE	PRICE
LNG-28	26-30 MHz	$49
LNG-50	46-56 MHz	$49
LNG-144	137-150 MHz	$49
LNG-160	150-172 MHz	$49
LNG-220	210-230 MHz	$49
LNG-432	400-470 MHz	$49
LNG-800	800-960 MHz	$49

HELICAL RESONATOR PREAMPS

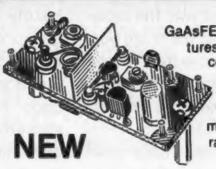


Low-noise preamps with helical resonators reduce intermod and cross-band interference in critical applications. 12 dB gain.

MODEL	TUNING RANGE	PRICE
HRA–144	143–150 MHz	$49
HRA–(*)	150–174 MHz	$49
HRA–220	213–233 MHz	$49
HRA–432	420–450 MHz	$64
HRA–(*)	450–470 MHz	$64

**Specify Center frequency desired*

MINIATURE PREAMPS



GaAsFET Preamps with features similar to LNG, except designed for LOW COST and SMALL SIZE: only 5/8"W x 1-5/8L x 3/4H. Easily mounts inside many radios.

NEW

Model LNW-(*) ..... Only $19/kit, $34wired

Models available to tune the following bands: 25–35, 35–55, 55–90, 90–120, 120–150, 150–200, 200–270, and 400–500 MHz.

*Specify band

IN-LINE PREAMPS

NEW

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RCVR
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hamtronics
LNS TRANSCEIVER PREAMP

GaAsFET Preamp with features like LNG. Automatically switches out of line during transmit. Use with base or mobile transceivers up to 25W. Tower mtg hdwr incl.

MODEL	TUNES RANGE	KIT	WIRED
LNS–144	120–175 MHz	$59	$79
LNS–220	200–240 MHz	$59	$79
LNS–432	400–500 MHz	$59	$79

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- **DTMF DECODER/CONTROLLER KITS**
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- **CWID KITS**
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gotten into the black in four or five months. Not bad for a retail operation. If you're into music, you might want to look into starting a CD-only store. It could turn into a chain.

There are a great many opportunities for people with an electronics background to start businesses. When microcomputers started I talked many hams into getting into the business. Some have done exceptionally well. Of course, if you're not using your interest in amateur radio as a way to build your electronic education, you're blowing a wonderful opportunity.

You might read through this issue of *73* and mark any parts that you don't really understand. Swallow your pride and corner a more technically apt ham and see if he can help you. He'll be flattered. Have I explained a fundamental fact of life recently? The more you get people to do for you, the more they'll like you. And the more you do for them, the more they'll hate you. So don't be shy about asking for help . . . it's the best way to make friends.

Speaking of which, I need your help. You may have noticed that *QST* is a tad fatter than *73*. This is a terrible situation—one which needs to be fixed as soon as possible. This is a situation where you can help. The formula is simple . . . the more advertising a magazine has, the more pages of articles it can publish . . . or club and operating news in the case of *QST*. A magazine generally attracts advertising in proportion to the number of readers it has. So if you can get some friends to subscribe to *73*, we'll have more advertising . . . more articles and a much fatter magazine. I'd love to have it up around 250 or 300 pages a month . . . but that's entirely up to you. Who do you know who should be reading *73*? Get after 'em.

If you have a job where unions are protecting your job and keeping you from progressing . . . I've had my share of that destructiveness . . . you're all set for long-term failure. You could hardly ask for a more secure grasp on failure. When I was in Chicago for the Consumer Electronics Show, I saw a *Chicago Tribune* union on strike—something to do with fighting work-saving plans by management. I suppose some bright college kid is trying to get them to shift from hand-set type to a Linotype machine. Tsk.

Even if you are completely settled in with failure in your own life . . . and have inoculated your kids with your same work ethic . . . how about getting your grandchildren off the treadmill? Would it really upset you if they became successful? Of course they're going to do as you do, not as you say. You're the role model, like it or not.

My grandfather helped Citgo get going back 70 years ago. My father started the first transatlantic airline. Neither did these things working 40-hour weeks, so I had excellent role models. I backed up this hard work ethic with education. When I got interested in amateur radio, I joined the school ham club and learned everything I could from the other kids.

It was my interest in amateur radio that pushed me into an engineering college instead of a liberal arts one. It was amateur radio that got me into the Navy radio-technician program, where I got a first-rate technical background in just a few months.

For years I learned, built, and experimented. I helped pioneer NBFM . . . then was an early sidebander . . . one of the first in RTTY . . . one of the first in repeaters. My family gave me a good start. Are you giving your kids or your grandchildren as good a start?

There are some good books on success. I enjoyed the one by Ray Kroc, the builder of McDonalds. The Napolean Hill book, *Think and Grow Rich*, is in paperback. It's also available on video cassette, audio cassettes, and so on. If you aim at success, in the long run your chances of reaching this goal are much better than depending entirely on luck. Failure can be ensured by constantly pursuing the temporarily expedient.

Any questions?

BUILDING YOUR CLUB

The strength . . . and the salvation . . . of amateur radio lies in our radio clubs. Buying a subscription to *QST* is not going to save our hobby. For that matter, even buying a subscription to *73* isn't going to save it . . . though it will tell me you are interested in working with me to save it.

The secret to a successful ham club is the same as the secret to a successful magazine . . . it's gotta be fun. Unless an awful lot of hams . . . well over 5,000 in the last couple of months . . . have been lying to me at hamfests, they were going to be dropping *73* before long because it was no longer fun to read. Well, you'll lose your members if your club isn't fun. It's as simple as that.

But how in heck can you make a ham club fun for a bunch of weirdos, all with different interests? We don't have one hobby, we've got dozens of 'em . . . and obviously there's no way to please everyone. Maybe, maybe not. But let's look at the positive side of it and get a move on.

Your Club Newsletter

This is the medium that can make or break a club. As the publisher of *73* I get to see hundreds of club newsletters. Some of 'em are awfully good . . . some are pathetic. They don't have to be slick four-color publications, you know. The main purpose of the club newsletter is to get the members to come to the next meeting . . . so tell 'em what fun they're going to have when they come. Tell 'em what's on the program. If there's going to be a short pre-meeting technical session to teach feedline theory, urge them to brush up on their radio by coming early. You might get the club program chairman to knock out an enthusiastic piece explaining what s/he's got in store for the next meeting.

Have you considered a buck newsletter flea-market column? For $1 you can list four or five lines of gear you have for sale. This beats the devil out of the several-month wait for a classified ad in *QST* to hit. I don't know how much you shop the ham magazine classifieds, but my experience has been that 90% of the stuff is long gone by the time the magazine with the ad finally comes out. Once you're through with a piece of ham gear, don't put it up on a shelf and forget it . . . get it moving to someone who will keep it busy, someone who will get enjoyment out of it. Never mind that you'll probably waste the money you get for it on nonessentials such as food or clothes for the kids.

If you have a ham store in your area, you might start talking with the owner about running a couple pages of ads in your newsletter. It won't cost him much, but that, along with the classified bucks, can make the newsletter fly by itself. How much should you charge? Well, I'd suggest around 10 cents per reader per page. Thus, a two-page ad spread might

Continued on page 104

SWL's: Are You Plagued By

Phantom Signals?

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Don't let its small dimensions (4"x3"x2") fool you—the Grove **Minituner III** is a big weapon against images, intermod and phantom signals on your shortwave receiver!

This short wave/long wave pre-selector is designed to boost performance in the 100 kHz-30 MHz frequency range. If you own one of the popular general coverage communications receivers and are using an outside antenna, you NEED this extra measure of selectivity.

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Ham Awards

Worked All States Award

by William V. R. Smith N6MQS

When you receive your first QSL in the mail, it's an exciting moment. It confirms contact with another ham. You begin to collect QSL cards and clear off wall space to display your cards.

Each day, you're excited about your new contacts. You start searching for new states. It doesn't take long until you want to contact all fifty.

Making contact with all fifty states is the first on-the-air goal for most radio amateurs. A high-power rig is not required; contact with all fifty states has been done by stations with only five Watts of power.

The first step is to get your paperwork organized. You'll need a list of all fifty states and a checklist for completed contacts which shows receipt of QSL cards. This list should be nearby when you're on the air. A U.S. map is useful to provide a visual aid, and each state can be circled as contact is made.

Making contact with each of the fifty states is only the first step. Most awards will require proof of contact. An operator in each state must send you a QSL card. There are three rules to follow to make certain you receive these cards: 1) You must send a QSL to get one, 2) Send a self-addressed, stamped envelope, and 3) Make contact with at least three stations in each state.

The attached WAS worksheet will simplify and organize your paperwork. It will also make the effort a lot more fun. Along with a list of all fifty states, the form contains room to log contact with three stations per state. Three contacts should insure receipt of at least one QSL card. Next to the state name is room for an 'X'. This will show that a card has been received and the state is complete.

Most "Work All States" awards have special endorsements. You may earn an endorsement for contacting all fifty state capitals, contact on one band, or contact only with YL operators. Most awards have several endorsements available: Review the award rules for a list of the endorsements. You can make photocopies of the worksheet and use a new sheet for each endorsement.

The U.S. map shown below will orient you to each state's location and its distance from your shack. The call sign areas are marked to help you identify a station's possible location from the call sign.

After you have completed the worksheet, it's time to apply for a "Work All States" award. Many nets and clubs have WAS awards available. The most popular WAS awards are presented by the American Radio Relay League (ARRL).

You may request an ARRL WAS award application by sending a self-addressed, stamped envelope to: ARRL WAS Award Manager • 225 Main Street • Newington CT 06111.

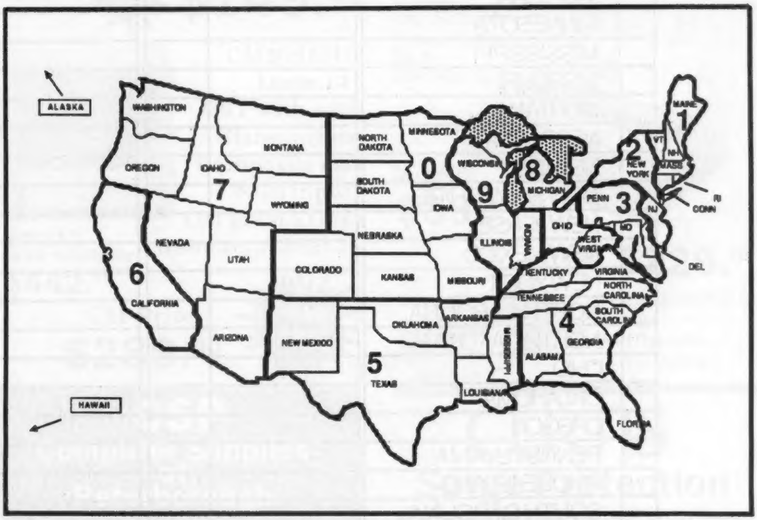
Along with the application, you'll receive a list of the many awards available and the special endorsements.

You will be required to fill out the application and sort your QSL cards alphabetically by state. The application and cards must then be mailed to the awards manager for verification. If you want the cards returned, you must enclose sufficent postage for their return (approximately two dollars).

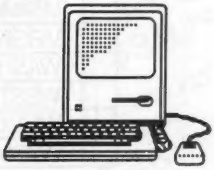
When everything checks out, you will receive a handsome WAS award in the mail. The award is shipped in a protective package to save it from the postal machines. The award will include your WAS number. This can be placed on your QSL cards. You have earned the award, so show off a little!

It took me almost four months to work all fifty states. In the process, I received over two hundred QSL cards from fifty states and thirty-five countries. I'm now working on state capitals and DXCC.

73 to you and yours. Good luck with "WAS," and I hope you tune in next month. N6MQS


ALASKA
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
MAINE
1
VT
NH
2
NEW YORK
MASS
OREGON
IDAHO
7
WYOMING
SOUTH DAKOTA
0
WISCONSIN
8
MICHIGAN
9
IOWA
PENN
3
RI
CONN
NJ
OHIO
MD
NEBRASKA
ILLINOIS
INDIANA
WEST VIRG
NEVADA
UTAH
COLORADO
KANSAS
MISSOURI
KENTUCKY
VIRGINIA
DEL
6
CALIFORNIA
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
4
ARIZONA
NEW MEXICO
OKLAHOMA
ARKANSAS
MISSISSIPPI
ALABAMA
GEORGIA
5
TEXAS
LOUISIANA
HAWAII
FLORIDA

U.S. map showing fifty states with all ten call sign areas. Circle each state as QSL cards are received. Alaska is in the seventh call area. Hawaii is in the sixth call area.



The award form presented here was designed on an Apple Macintosh by N6MQS and printed on a Laser printer.

WAS WORKSHEET QSO COMPLETED

STATION: ____________

SPECIAL: ____________

X	STATE	CALL	DATE	CALL	DATE	CALL	DATE
	ALABAMA						
	ALASKA						
	ARIZONA						
	ARKANSAS						
	CALIFORNIA						
	COLORADO						
	CONNECTICUT						
	DELAWARE						
	FLORIDA						
	GEORGIA						
	HAWAII						
	IDAHO						
	ILLINOIS						
	INDIANA						
	IOWA						
	KANSAS						
	KENTUCKY						
	LOUISANA						
	MAINE						
	MARYLAND						
	MASS.						
	MICHIGAN						
	MINNESOTA						
	MISSISSIPPI						
	MISSOURI						
	MONTANA						
	NEBRASKA						
	NEVADA						
	NEW HAMPSHIRE						
	NEW JERSEY						
	NEW MEXICO						
	NEW YORK						
	NORTH CAROLINA						
	NORTH DAKOTA						
	OHIO						
	OKLAHOMA						
	OREGON						
	PENNSYLVANIA						
	RHODE ISLAND						
	SOUTH CAROLINA						
	SOUTH DAKOTA						
	TENNESSEE						
	TEXAS						
	UTAH						
	VERMONT						
	VIRGINIA						
	WASHINGTON						
	WEST VIRGINIA						
	WISCONSIN						
	WYOMING						

an N6MQS form

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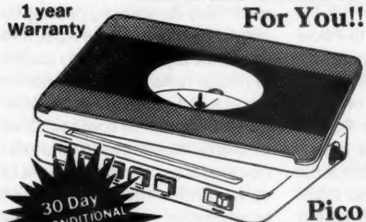

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$69.95

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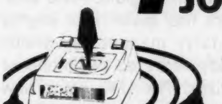
PICO JOYSTICK



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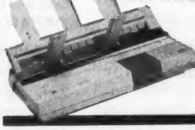

M-1109 **$229.00**

Highspeed 1000B NLQ
2k Buffer
Quiet Operation
Loads of Options

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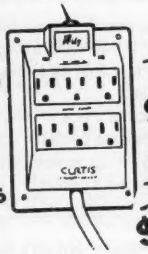
Surge Protection

Protect your investment with these Curtis Surge Protectors. Just *LOOK* at these prices!

Ruby ~~$89.95~~ **$58.95**

Sapphire ~~$79.95~~ **$52.95**



Emerald ~~$59.95~~ **$39.00**

Diamond ~~$49.95~~ **$36.95**

NK6K>PACKET

Harold Price NK6K
1211 Ford Avenue
Redondo Beach CA 90278

It struck me the other day that people not on packet wouldn't know where the title of this column came from. On packet, when you're just monitoring the channel, your TNC tells you who each packet came from, and who it's going to. If NK6K were sending packets to a station called PACKET, each packet would be displayed with NK6K>PACKET: in front of it. That's all there is to it!

PACKET IN OTHER LANDS

A more or less regular feature here for the months to come will be a review of worldwide packet activities. Hams in other countries have a different perspective, and operate under different rules. The questions I've asked packeteers in other countries are:

1) How many packet users are there?

2) What packet standard is in use?

3) What frequencies are in use?

4) Are there any regulatory restrictions on the use of packet?

If you don't see your country mentioned, feel free to send in the answers. This column was written on May 28, and most of the DX comments were received earlier in the month.

Japan

These comments were received on CompuServe from Toshi JG1REA:

"The exact number of packet users is unknown but growing fast. AX.25 is used in almost all cases. The UHF band is most commonly used; frequencies around Tokyo are 430.98, 431.0, 434.0, and 434.44 MHz (430.98 is the most active). The 1.2-GHz band is in use around Osaka. Many Americans are applying for the new reciprocal licenses. 7J1AAA (AH0A) operates a PBBS in Tokyo."

In conversations with other JA and U.S. hams, many have noted that packet growth in Japan has been slower than might have been expected given the high interest in computers there. One possible reason suggested was that the general crowding of the VHF and UHF bands made it hard for a new mode to "clear space." Also, since the TNCs and software were developed in the United States, initial Japanese participation was limited to those who could work well in English. Early difficulties with TNC software in passing 8-bit data made it hard to send the various Japanese extended character sets through the TNCs. These problems have been largely overcome, and the packet transponder aboard the JAS-1 satellite should spur further interest.

South Africa

These comments were received on Telemail from Hans van de Groenendaal ZS6AKV, President of Southern African AMSAT:

"Packet radio first came to South Africa when Gordon Hardman ZS1FE/KE3D returned to Cape Town after the launch of OSCAR 10. He brought two TAPR Beta units which were extensively demonstrated at a SA AMSAT Satellite Communication Conference.

"After the launch of TNC-1 by TAPR, some 30 units found their way to the Johannesburg/Pretoria area. This was further boosted by TNC-2 and various models of the GLB units. Now the AEA Pakratt and PK-80 are further stimulating the packet revolution.

"In 1985 the first digipeater, ZS6LAN, was set up in the Johannesburg area, followed by a packet-radio bulletin board in Pretoria. Unfortunately, earlier this year lightning struck and blew up the bulletin board system. It was expected that a new system using the WA7MBL software and IBM-compatible hardware would become operational in June/July 1986.

"One of the first TAPR Beta systems is now used at the Johannesburg Amateur Radio Center.

"The total number of packet-radio stations in South Africa is estimated to be around 100, with the major activity centered around Johannesburg/Pretoria, Durban, Port Elizabeth, and Cape Town.

"The general operating frequency is 144.675 MHz.

"Plans for this year include setting up a digipeater system to connect Durban and Johannesburg/Pretoria."

United Kingdom

The U.K. has gotten off to a slow start mainly due to regulatory issues. Repeaters are tightly controlled by the Department of Trade and Industry and by the RSGB; currently, digipeaters are not allowed. The following comments came via the Uo-11 Digital Communications Experiment from Jeff Ward G0/K8KA, a temporary resident of the U.K. who is working on an advanced degree at the University of Surrey. He says that this is his understanding of the situation. The matter is still under review by the RSGB and the DTI, and neither body has made any firm policy statements on the matter yet.

"Activity: approximately 200 stations are equipped for AX.25. Centers of activity are in the London area, the Southwest (Devon and Cornwall), and East Anglia. The local activity is on 2 meters, with no generally agreed upon frequency at this time.

"In the near future, RSGB is expecting permission from the Department of Trade and Industry for a number of packet-radio repeaters on 2 meters. The frequencies 144.650 and 145.275 will be occupied by this network until the end of 1987, when UHF or microwave frequencies for packet will be identified. The 2-meter frequencies are being used in the short term, because most of the people interested in getting on packet radio will already have 2-meter capability, and the RSGB does not wish to force people to buy both packet-radio equipment and new rf equipment to enter the packet network. The 2-meter band is very crowded in IARU Region 1, however, and so, as packet activity increases, the network MUST move to higher frequencies.

"The current working definition of 'packet-radio repeater' is any store-and-forward device, which includes digipeaters, PBBS systems, and any higher level network relay device. Digipeating by individual stations is not legal, and will not be legal in the early stages of packet-radio implementation in the U.K. All repeaters in the U.K. must be separately licensed. One-to-many messages (bulletins, newsletters, messages to ALL) come under the definition of broadcasting, and will not be allowed initially, either. In the second phase of regulatory investigation, it is hoped that the DTI will allow limited bulletin-type messaging (at least by official bodies already generating bulletins) and reconsider the third-party-traffic clauses. RSGB hopes that amateur-to-amateur-via-amateur traffic will be exempt from third-party clauses.

"The DTI blessing for packet repeaters is expected to be granted quite soon, and while it usually takes several months to get a repeater license in the U.K., a few packet-radio repeater licenses may be sped through the process, resulting in an operational network by midsummer."

The initial close regulation may work to the advantage of network planners in England. The U.S. network has grown in a slightly topsy-turvy manner as various methods were tried, expanded, or discarded. The U.K. hams now have that base of experience to work with, and they can start out with a second-generation system, taking the best of what is available

DIN Connector		Mini-Plug	Sub-Mini-Plug
pin 1	(use center of shielded cable) (put 2.2-uF tant. in series)	middle sleeve	
pin 3	(same cable as above-use) (shield . . .)	big (top) sleeve (tip is unused)	
pin 4	(second piece of shield cable-use center)		tip
pin 2	(big center lug-use shield from pin 4 cable)		sleeve

Table 1. Wiring a Kenwood TH-21/31/41 for packet operation with a TNC-2/200/2A.

and developing new systems without having to maintain backwards compatibility with older installed systems.

Network Statistics

We need some. Most of our current metrics on network performance are subjective, i.e., based on perceptions of performance, as in "The path up north was really useless last night." While user happiness is one of the prime goals when tuning a network, best results are gained with a more quantitative measurement. If you're looking for something to do, how about implementing some network analysis tools? We're so bad off now, almost anything you'd do would be a vast improvement. Here are some questions we need answers to:

- What is the average size of a packet?
- What is the average number of digipeater calls in a packet?
- Which callsigns originate the most packets?
- Which callsigns receive the most packets?
- How many unique callsigns appear on the frequency each interval?
- What is the average number of retries?
- What is the average number of simultaneous active connections on the frequency?
- Which digipeaters receive the most use?
- For mailboxes, what is the split between local messages and messages destined for other systems? What is the split between personal messages and to-ALL messages? What is the distribution of file sizes normally seen on the network?

All of this needs to be broken out by various time intervals and plotted by time of day/week/month, etc. Each local area will be different.

The performance of the next round of networking software can be affected by all of these parameters. The network will also be more complex and have even more "tuning knobs." If we can't tell how well the network is running at time T, how will we know if we've improved it at time T1?

Just to put you in the numbers mood, here's a statistic we do have. The *NEPRA PacketEar*, the newsletter of the New England Packet Radio Association, keeps track of total message counts for 24 BBS systems in the New England area using figures gathered by W0RLI. They report a total of 5171 messages handled in the period 4/12/86 through 4/28/86. For this number, a message is counted each time it passes through a BBS, so if one message were forwarded 13 times in New England, the count would be increased by 13. While there were not 5171 unique messages, the BBS systems did pass messages 5171 times between them. How many unique messages were there? Someone should write a program to figure that out.

Speaking of things to do, here is a list of other things that haven't been done, or things that have been done but haven't been written up, which might as well be the same thing.

- SSTV through packet—I know that some graphics files have been sent, but has anybody taken a camera and digitizer, hooked them up to packet, and let them rip?
- Voice through packet—There are fancy ways to do this, and then there are brute force methods. If someone comes up with a simple audio-to-bits and back-again circuit, I'll send your audio file up to UoSAT-OSCAR-11, we'll get it downloaded and played out in England, and you'll be in the record books for the first amateur transatlantic store-and-forward voice-gram. You can get a lot of "Hello, OM" into 96K of memory. Even with a simple 6-kHz, 8-bit A-to-D, you can get 16 seconds of message sent. Squeeze the file, and you'd get 25 to 30 seconds. Get fancy, and get more. Any takers?
- Packet above 440 MHz—TAPR and AMSAT ran packet between their booths at Dayton one year on a pair of loaned ICOM 1.2-GHz rigs. Is anyone doing it on a regular basis outside of Japan? Anyone taken a pair of 10-GHz Gunnplexers and pushed packets through them?
- Network map standard—There are several different "network maps" around, from the pin-and-yarn map seen at conventions to the multi-K-byte EASTNET map. All of them are hard to read, and all are hard to update and integrate. Anyone have a good idea how to print a network map?
- Network user database—I know I want to send mail to VE3GYQ, but I don't know which BBS he gets his mail from. Short of calling him up and asking, which takes all the fun out of it, how do I find out? If he has a BBS, how do I know which BBS routes mail to him? I've seen several attempts to start local, regional, and national directories, and there are at least three ongoing in southern California now. Anyone have an idea on how to make the updating job easy, and how to share data across local network boundaries?

We've got a lot to do, and if the trend of the age of the average ham increasing one year per year continues, we don't have much time left to do it in. (On the other hand, counting users would get easier every year!)

Kenwood TH-21

Several people have asked for information on how to hook up a TNC to the Kenwood shirt-pocket radios. I put out a call for help, and got the information from the Radio Amateur Telecommunications Society (RATS). Their address is 206 North Vivyen Street, Bergenfield NJ 07621, should you be in their area and want to join. Table 1 gives the details.

That's it for this month. ■

FUN!

John Edwards KI2U
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Middle Village NY 11379

ASPIRATIONS

When you're young, you have aspirations.

Most young men and women have very normal goals in life. Some kids want to work hard and become captains of industry, others dedicate their lives to science, and a few look for an easy way out and pledge their lives to politics.

As a teenager, I also had goals, one of which included becoming a repeater owner.

Ah, repeater ownership—there's the life. A repeater of your own. No one telling you that you're hogging the machine, reminding you to leave a pause between transmissions, or hounding you for membership dues. You're the boss, number one, numero uno, head honcho. The Big Cheese.

When you're 22, as I was in 1976, those are powerful thoughts. When you're 22, a dyed-in-the-wool ham, a B student at a commuter college on Long Island, and someone with no aim in life, repeater ownership is nothing less than an aphrodisiac.

So one fine spring evening in 1976 I asked my friend, Jon WA2MJK, if he was interested in launching a repeater.

"A repeater?" he said, looking at me as if I had asked him to join me on a DXpedition to Venus. "They cost money!"

Jon always was sort of practical.

"Sure they cost money," I replied. "But if we build one from a kit, we can save a lot of dough." I then hauled out a copy of *73*, and showed Jon an ad from a company in Binghamton, New York, that sold repeater kits.

Jon looked at the ad, then raised his eyes toward me in a most skeptical fashion. "John," he said, "the only kit you ever built was a Heathkit Sixer and, if I recall correctly, that never worked right because you left six-inch-long leads on all of the resistors.

"I know," I replied, "but that was 1969. I'm an Advanced now. I know better."

So the discussion continued for the rest of the evening, with Jon pointing out the headaches of repeater ownership while I spun a tale of glory and power. In the end I won. I had Jon wrapped around my little finger.

The next several weeks passed quickly. There was equipment to build, frequencies to acquire, FCC applications to fill out, antennas to erect, and spirits to sag.

The first assault on our hopes came from the ARRL frequency coordinator, who we cornered at a meeting of the local repeater council. The coordinator responded to our request for a 2-meter channel pair with the same bemused attitude a loan shark exudes when asked for extra time on a loan. First he laughed, then his nostrils flared in a most nasty way.

"A 2-meter pair? I got loads of them. They're in my pockets. Look, see," he said, turning his trouser pockets inside out.

Feeling a length of RG-8/U tighten around my gut, I croaked out, "How about 450?" figuring that UHF was better than nothing.

"Look, kid, you want a repeater,

go use one. New York is the repeater capital of the western world. We got repeaters here that haven't had a human voice on them since Maxim invented coffee. We're talking about an underutilized resource, pal."

The repeater coordinator was tiffed. Jon started sniffling. I felt sick.

Then, I don't know what it was. Pity, I think. Jon and I were looking fairly pathetic, which was a typical state of affairs for the two of us.

The coordinator glowered, raised his eyes heavenward, and said: "Look, guys. I know you fellas are never going to get a machine up anyway, and I got a pair of 220 frequencies. Some club up in Westchester was supposed to use 'em, but they never got their act together, either. They're yours for a year. Get a machine up and they're yours forever. In a year, maybe that Westchester bunch will be ready to go."

Two-twenty. Yoweee. We were in business.

"The next step," said Jon, alternately sucking down a beer and puffing on a Salem in the mature manner that only a recent graduate of Youngstown State University could muster, "is to build the machine." He was right.

So we ordered the repeater kit from that company in beautiful Binghamton, New York. Another *73* ad had won another customer. The kit, when it arrived, was beautiful.

"Look here! It's a chassis!" shouted Jon, his eyes aglow, as his fingers clawed into the massive crate.

"To hell with the chassis," I yelled. "I got the reset button!"

Immediately, we began dividing up the parts packs. I made the assignments.

"The receiver's for you, the transmitter's for me, the carrier-operated relay's for you, the IDer's for me." Already the power was rushing to my head.

The work went quickly, the repairs went slowly.

"Worst damn soldering job I've ever seen," said the tech in Binghamton on our second visit to that fair city on the shores of the Susquehanna. (The first trip back to Binghamton had failed to sort out our repeater's problems. It's funny how little cold solder joints can have such a major effect at 220 MHz.)

"Heh-heh," I chuckled, in my best Edward Arnold-style insincere laugh. "You know how little brothers are," referring to my blessedly innocent sibling, Jim WB2LWJ. "Last time I let my damn kid brother work on a circuit for me," I said.

Some folks have claimed I have a bit of the pathological liar in me. Nevertheless, with the now-repaired machine, I was the chief control operator of what I knew would become the Big Apple's premier 220 repeater.

Of course, being the chief control operator of a New York 220 repeater, at least in the 1970s, was a bit like being king of the North Pole—your kingdom had plenty of land coverage, but few subjects. But that fact was still unknown to two innocent hams.

Standing in my parents' basement, a Station Master perched on the roof, Jon and I jointly flicked the Master Control Switch. A red pilot light glowed, a hiss spilled out of the repeater's speaker, and the transmitter tripped. I expertly adjusted the squelch knob until the hiss disappeared and the transmitter unkeyed. But as I was doing this, the IDer kicked in: Dit dah dah, dit dah dit, dit dit.... WR2APG was open to the world. A salty tear rolled down my pudgy little cheek. A tingle went up my spine. I had reached the pinnacle. I had peaked. The only way left was down.

The next few weeks went slowly. "Silently" might be a better word. Precious few souls visited WR2APG, the pride of Glendale. Occasionally, a passing mobiler would stumble across the frequency, give a call, and then, after getting a 25-minute greeting speech from Jon, rapidly move on.

For six long weeks, we had three regular users: Jon, myself, and Pierre, a retired prison guard who lived in Manhattan. Pierre was the only other person we knew who actually owned a 220 rig. We used to steal him away from the NBC repeater for QSOs.

At night, I would lie in bed listening to the COR thump, the sound grumbling up through the floor. Occasionally, I would hear Jon's muffled voice say, "WA2MJK listening, WR2APG." Sometimes, I would hear Jon kerchunk the machine. I knew it was Jon because Pierre went to bed early. On the whole, generally speaking, it was pathetic.

Things got worse. A storm knocked the Station Master over. We fixed it. A taxi company caused intermod. We fixed them. Then Jon, who was in advertising, got a job offer from a midwestern firm that was a direct-mail record manufacturer. "The 101 Collected Hits of Allen Ludden" was their big hit. You may have seen the commercial on TV. The company also repackaged classic movies with modern personalities. Remember "Oy! A Yankee Doodle Dandy!" starring Myron T. Cohan?

Without Jon's 50-percent financial support, WR2APG couldn't go on. After all, a $10 a week allowance can only carry a repeater so far. New York's premier unused 220 repeater was heading for bankruptcy.

So we sold our beloved machine to a group of guys who already operated a wildly successful 2-meter repeater. They said they were going to place our baby, built with our own hands and rebuilt by the tech from Binghamton, on top of the Empire State Building. Show-offs, right?

Well, they did it. Within two-and-a-half weeks the guys from 2 meters were up there running autopatches, crosslinking over to 10 meters, setting 220 DX records, holding Dean Martin celebrity roasts for ARRL officials, and having a grand time. I would listen at night, holding my HT on my lap. The IDer sounded so familiar, the callsign so foreign. In 1979, short for cash, I sold my 220 rig. I haven't been back on the band since.

Not so long ago, Jon moved back to New York. The record company went belly-up after it diversified by marketing Rod Carew snowshoes. The infamous Mild Winter of 1985 caused the firm's frozen assets to melt.

Sometimes, when the moon is full and our heads are empty, we reminisce about old WR2APG. The times we almost had, the people we didn't meet. The power I wanted to wield.

One recent night, Jon recalled an incident of 220 repeater lore.

"Remember the time you hollered at the FCC representative because he announced they were discontinuing 'WR' prefixes?" Jon said.

"That was at the '77 ARRL New England Division Convention up in Hartford, wasn't it?" I replied.

"Indeed," said Jon. "If that fellow was a member of the radio police, he would have taken you from Hartford to Danbury and thrown you in the federal pen."

"I got kind of attached to WR2APG," I said.

"Bad manners. Bad form," said Jon.

"Aw, damn," said I.

"That was the mildest epithet you used," said Jon.

The other day, I asked Jon if he was interested in starting a computer bulletin board.■

RTTY LOOP

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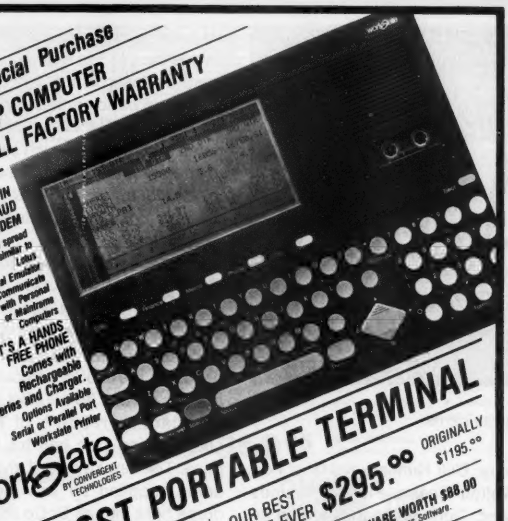
My faithful readers will have noticed that last month's *73* was devoted to the phenomenon known as packet. I have covered packet in various aspects in the past year or so, and today I have a different way of looking at the subject. Let's have a look at some packets you all have sent me, in the mail, of course! (Well, somebody has to be an individual!)

Several times in the past few years I have mentioned a RTTY program for the Apple computers that I knew only as the "Galfo" program, and I have repeatedly asked for information on it from all of you. Well, this month, several of you have dropped me a bit of information. Al Sines WA3QGA in Laurel, Maryland, tells me that he has the version of the program supplied by AEA (Advanced Electronics Applications) with his CP-1 interface. He relates that it works with all versions of the Apple II series up to, but not including, the Apple IIe.

John Donohue AB7M of Seattle adds a little more information. He tells us that the program was written by Dr. H. Christopher Galfo WB4JMD in 1978. It requires Integer Basic, and to run it on other than the Apple II requires an Integer card or a RAM card in slot 1 so that the Integer Basic may be loaded from disk.

Operation on Baudot (Murray), ASCII, and CW is available. Bau-



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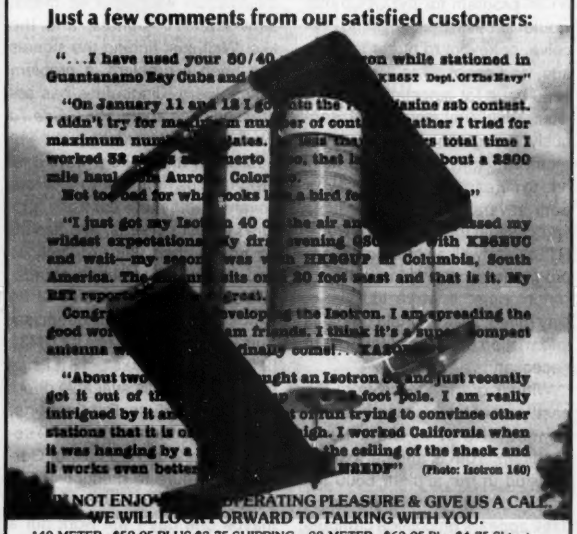

"...I have used your 80/40 [illegible]on while stationed in Guantanamo Bay Cuba and [illegible] KB6SY Dept. Of The Navy"

"On January 11 and 12 I go[illegible] into the [illegible] Magazine ssb contest. I didn't try for ma[illegible]m number of cont[illegible] rather I tried for maximum num[illegible] states. [illegible] total time I worked 52 st[illegible] and Puerto [illegible]o, that [illegible] about a 2800 mile haul [illegible] Auro[illegible] Colorado.
Not too bad for what looks [illegible] a bird fe[illegible]"

"I just got my Isot[illegible]n 40 on the air an[illegible]sed my wildest expectations. [illegible]y first evening QSO [illegible] with KB6EUC and wait—my secon[illegible] was w[illegible]h HK3GUP in Columbia, South America. The [illegible] sits on [illegible] 20 foot mast and that is it. My RST report[illegible] great.
Congr[illegible] developing the Isotron. I am spreading the good wor[illegible] ham friends. I think it's a super compact antenna w[illegible] finally come!...KA5O[illegible]"

"About two [illegible]ught an Isotron 80 and just recently got it out of th[illegible]p [illegible] foot pole. I am really intrigued by it an[illegible] of run trying to convince other stations that it is o[illegible]igh. I worked California when it was hanging by a [illegible] the ceiling of the shack and it works even better [illegible]NSEDF" (Photo: Isotron 160)

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dot and ASCII speeds are from 32 to 300 baud; CW can be run between 2 and 125 words per minute. CW receiving speed is adjustable by the program from 1/3 to 3 times the selected speed.

AEA, Inc. (PO Box C-2160, Lynnwood WA 98036) has this program available as "CP-1/Apple-1." The price, according to John, is $29.95. He says that the program is furnished on a DOS-3.3 disk together with a connecting cable to run between AEA's CP-1 modem and the Apple II's 16-pin DIP game port.

John adds that operation of the Galfo program is easy enough, although a newcomer to RTTY may have to study the documentation from time to time until he is at ease with all the features. The only problem he has had with it is that the function which provides for storing a message for later transmission seems to be limited to about 250 bytes.

Thanks for the information, fellows, and I am sure that Apple owners appreciate the guidance.

Maryland
WA3AJR
Amateur Radio Operator

Maryland recognizes hams.

Okay, folks, now listen up. Earl Morris N8ERO passes along the news that as of this writing (end of May) he has a Model 15 Teletype machine offer to anyone who would like it. Assuming it is still available, contact him at 3200 Washington, Midland MI 48640.

Newcomers are always welcome to RTTY Loop, and I have a letter here from Gary Halbe N3EMY in Willowgrove, Pennsylvania. Gary says that he is a "relatively new ham and very excited but confused at the same time. There seem to be many, many directions in which to go, and it's quite difficult with limited time and finances to do it all. However, I do enjoy the digital communications aspect quite a bit. I have enjoyed computers for some time. In fact, that is partially what got me into amateur radio. Anyway, not to digress too much, I also read your monthly RTTY Loop column and find it very interesting and informative even though I do not have a RTTY setup at this time. I do hope to set up a RTTY station shortly, though, and at work they were discarding what appeared to be a fairly new Teletype machine. As I have several computers in the house, I took the opportunity to get a free printer. As it turns out, this machine did not print what it was supposed to be printing. I searched around for model numbers, etc., and found several bits of info.... The manufacturer is Siemens. I phoned them to see if they could shed any light on why I could not properly connect this to my computers. The person I spoke with informed me that the reason was my computers were using ASCII and the Teletype was using Baudot. Now my question to you is did I find myself an inexpensive piece of gear I can use on RTTY, and if so, where can I find more info on what I need for interfacing, programming, etc.? Just a little more info which may be helpful in your determination is that this Teletype has the tape punch and reader. I believe it was hooked up to a phone line, and it has three wires, send (+), rec (−), and gnd.

"I wish I could give you more info such as a model number or whatever, but at the moment I can't. If the info I did give is enough, please let me know what to do with it and/or how to do it. Hopefully, it will all work out and sometime in the near future I will be on the air. If it is useless and I have some piece of worthless space-eater, let me know so I can lug it out of the shack and have some room again."

Hoo boy, Gary! Siemens is a German manufacturer that has built quite a variety of devices, from the teleprinter you describe to the electrocardiograph machine in my office. Even a picture would be helpful to try to figure out just what you have. Even better, if there are any RTTY-o-active hams in Gary's vicinity, why not give him a call and see if a hands-on session doesn't do the trick. Let me know what happens, Gary.

Timex/Sinclair folks, your turn! Don Cain NJ6Z of Los Angeles has used the NARP program for the Timex/Sinclair ZX-81 for receive, and feels it worked well. He passes along the information that NARP also uses a terminal unit designed by the author of the software, Cliff Nunnery NU4V of Fort Walton Beach, Florida. Sounds good, Don, and thanks for the information.

On the other hand, Gregory McKenna VE2AGY of Chateaugay, New York, owns a Timex 1000 computer and would like to put his machine on RTTY, too! Anybody? I have searched my files, such as they are, and have turned up nothing on the 1000. (I know, somebody is going to send me an old column where I mentioned the thing. I never said I was organized!) Anyway, let me hear from you if you are using a Timex 1000 on RTTY, and I will publish the information for all to benefit.

Phillip H. Creasy, Jr. KC3FG of Hermitage, Pennsylvania, says that he would be interested in a RTTY program for the CoCo that would access disk to send, receive, or keyboard buffer for storage, and spool off to a printer at 1200 baud for autostart RTTY. At least, Phil! Why stop there? Seriously, though, the wish list is well received. Now, I am not normally one to spread rumors, but I have it from several reasonably reliable sources that there are a few CoCo RTTY—as well as other modes—programs soon to be announced—right here, if we're lucky! So, stay tuned. I will not hold onto this information one issue longer than necessary.

Winner of the "voice from the past" award for this month is Tom Kennedy K8TK of Clark Lake, Michigan. Tom is another one interested in the ancient 6800 microprocessor which, he says, "still appears on college campuses and seems to be one of the best processors to 'cut your teeth on.'" Thanks for the other good words in your letter, and a copy of the reprint list is on its way to you in the mail. That reprint list remains available for any of you, of course, for a self-addressed, stamped envelope sent to the address at the head of this column. I have put together a bunch of material from the early days of this column, updated and revised, which seemed to interest many of you. Feel free to send for the list and look it over. It'll only cost you a stamp—the list, that is.

I have mentioned a few items of interest to CoCo owners in the past, and here's another. Bob "Whiffle" Rosen, the ham whose Spectrum Projects cater to the needs of the CoCo computerist, advises me that he will offer a new keyboard to readers of RTTY Loop at less than half his usual price. The new keyboard, the type being supplied on new CoCos, drops right into all CoCo IIs, "F" boards, and TDP-100s. Normally selling for $39.95, it is being offered for $14.95. An adapter for D or E boards is also available, for $9.95. Add $3 shipping and handling for each keyboard, and send orders to Bob at PO Box 21272, Woodhaven New York 11421—be sure to ask for the RTTY Loop special. By the way, Bob adds that if you get a few folks together, six or more keyboards ordered at one time will drop the price to just ten bucks apiece! Thanks, Bob.

Another topic we have touched upon here in the past has been WEFAX. This facsimile transmission, frequently heard along the HF spectrum, is a potent source of information with weather maps, slow-scan TV signals, and the like. Well, just finding the signals has been a problem, a problem which Joerg Klingenfuss has addressed once again. His *Guide To Facsimile Stations* has just been published, and quite a work it is! Frequencies from VLF to UHF are covered, with more callsigns, pictures of test patterns, and assorted advice than you are likely to find in any other single source. There are even schedules of 94 FAX stations on 340 frequencies. This valuable tome sells for DM30 [2.27 Deutschmarks = $1 as of early June] and is available direct from Klingenfuss Publications, Hagenloher Str. 14, D-7400 Tuebingen, Federal Republic of Germany. Be sure to mention RTTY Loop if you write. Who knows, maybe one day I will work out a stateside distribution arrangement with them (Hoeren Sie, Joerg?).

In a couple of months, we will be looking at some of the items you all have found useful for RTTY in the annual shopping guide. How

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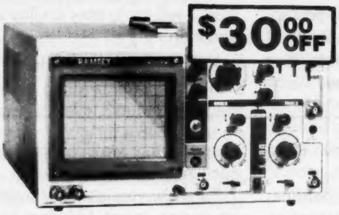

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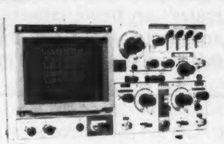

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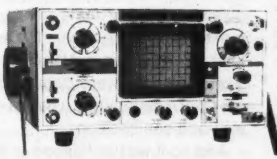

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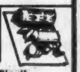

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about some nominations, folks? Drop me a line, either on paper or via E-mail, with your vote for the more useful RTTY items available, and, if you like, the klunker of the year. Try to get the information to me as soon as possible for inclusion in this year's guide.

Still very little curiosity out there about Green Keys! What if I tell you that they were NOT named for Wayne?

One closing note, the photo this month is of our new Maryland Amateur Radio Operator license plates. Aren't they nice? They even *say* "Amateur Radio Operator" on them, reflectorized, and everything! I just thought that those of you who still may be fighting for callsign tags might like to see these new designs. If anyone from our State Motor Vehicle Administration happens to be a ham reading this column, thanks!

More fascinating stuff on tap, with my promise to look at at least one thing that nobody else would look at. Of course, I look forward to your comments, as always, via the postal service or CompuServe (ppn 75036,2501), but now you can add Delphi to the list, username MARCWA3AJR. As long as I can afford the connect fees, I will try to stay on-line now and then.

Until next month, then, that's it for RTTY Loop!■

LOOKING WEST

Bill Pasternak WA6ITF
28197 Robin Avenue
Saugus CA 91350

COORDINATION FEES or HOW MUCH AM I OFFERED FOR .16/.76?

Hams may soon find themselves paying for repeater coordination! The FCC says that no specific rules exist to preclude repeater frequency coordinators or councils from charging fees for coordinating, moving, or maintaining a repeater's coordinated status.

This information came to light in early May as the result of a meeting between opposing factions of Alabama repeater owners and FCC field personnel. The meeting was ostensibly to determine what two-meter band plan Alabama would follow and who would oversee future Alabama coordination efforts. Some of those in attendance favored the continuance of the existing Alabama Repeater Council plan, with its mandated imposition of the Pacific Northwest 20-kHz band plan in the 146–148-MHz subband allocation. Others said that 20 kHz was not working; that it caused interference to systems on 15-kHz centers in neighboring states. They said that the Alabama Repeater Council had acted unilaterally by forcing them onto 20 kHz. They were demanding a return to 15-kHz channel spacing and the dissolution of the new alliance with the CVRA Southeastern Repeater Association even though the CVRA had previously stated it wanted no part of Alabama until it straightened things out.

CVRA founder Wayne Williams K4MOB had told me that the CVRA was not going to walk in and attempt to solve the problems of another area, and he did not want his organization accused of pillaging another state simply to make itself even larger. Regardless of what some Alabama repeater owners were demanding, the CVRA maintained a hands-off, wait-and-see position.

And so it was to happen at this meeting in Birmingham on May 10 that officials from the FCC's Atlanta field office would be asked one key question: Was it possible for whomever would wind up coordinating repeaters in Alabama to collect a fee to offset the cost of performing frequency coordination and maintaining an accurate data base?

At that time, the FCC people could find no specific regulation that precluded the collection of fees. Wasn't there anything in the Part 97 rules to cover this? How about the regulations covering pecuniary interest on the part of hams, preventing them from receiving compensation for voluntary services rendered? Well, to make it brief, subsequent conversations between this reporter and various Washington FCC officers also failed to find anything specific to keep such fees from being imposed and collected by coordinators. Also, under the present regulations, there is no maximum limit on what such a fee might be.

While the regulations covering the VEC program that permit collection of a specific amount to reimburse VECs and VEs for their out-of-pocket expenses might be applicable here, unlike the VEC program, the costs involved in frequency coordination vary greatly between geographic regions. This is because of such variables as the number of hams served, the demand for repeaters on a given band, and the spectrum still available for new systems. Deriving a fee schedule for coordination and maintenance of coordination data for each geographic region might prove to be impossible.

For example, a single coordinator in a sparsely populated region such as Idaho might have negligible operating costs because he has relatively few repeaters to be concerned with, a fairly small amateur population, and plenty of room for new systems on every band from 10 meters up to light! On the other hand, the same job for a major coordination council serving a state like New York, Illinois, Texas, or California might find its costs running into the hundreds or even thousands of dollars to perform the same individual task for each new repeater or change demanded by an existing system.

If you set a single national fee based on the average costs to all councils combined, there will be some very wealthy coordinators in the hinterlands with little to do, while their city cousins are fighting to make ends meet. Or at least they'll be making that claim, since permitting fees to be collected for coordinating ham repeaters does immediately commercialize amateur relay operation one more step.

The Analysis

First, let me go on the record as violently opposing any coordinator or coordination council being permitted to collect anything for any work. We must remember that in speaking of coordination, we also have the word "voluntary." To me, that has always meant that *everyone* involved in the coordination process is performing on a voluntary basis. Unfortunately—at least in Alabama—there appear to be some who feel that the position of coordinator or coordination-council member should be a paid position, and that the person putting up a repeater should pay the costs. Well, what happens to the meaning of "voluntary" then? Half of it disappears. Also, without a maximum allowable fee, such coordination charges would be open to abuses by individuals or groups who might see in the situation an easy way to profit from such an undertaking.

To show you just how outlandish this could get, let's look at the all-volunteer testing program for a moment. You will notice that one publication, the *W5YI Report*, written by my friend Fred Maia, is accredited as a VEC in all testing districts. While the FCC hates the term, Fred is a de facto national VEC. With this as a precedent, why shouldn't *73* become a "Frequency Coordinator Accredited in all States and Coordination Districts"? Absurd? You bet, but I'll also bet that there will be some individual or group who will do just that if coordination fees are permitted.

Let's continue this stupid hypothesis for a few more paragraphs. Obviously, we must figure out a fee schedule that is based on "average" cost nationally. Well, turning to the various land-mobile service coordination groups, we note that the average is only a few thousand dollars per system. Since the cost to find a home for a ham repeater is not really any different in the amount of labor and time than finding a home for a land-mobile system, it's obvious that the same charges would be equitable. Right? So, since we obviously must charge based on a "national average" of costs involved, we find that $2,000 for initial coordination and $200 per year for maintenance of the data base is about right.

But wait! What about the coordinator or council already serving your area? The guys and gals who have been doing a good job, free of charge, for many, many years? Well, there is nothing to keep them from coordinating repeaters as well. In fact, if we again use the all-volunteer testing program as our guide, you note that there are the de facto national VECs such as the *W5YI Report*, the ARRL, Metroplex, and DeVry. There are also many regional VECs that serve only one specific call area, such as the Sunnyvale VEC, the Greater Los Angeles Amateur Group VEC, and the SANDRA

VEC. All serve only the 6th call district, which also happens to be the 6th testing district. So, the 6th district is served quite well by seven VECs!

Coordinationwise, California has four officially recognized repeater councils plus a few "splinter groups" as well. In the northern half of the state, the Northern Amateur Relay Council has been the main entity for a decade and a half. (Its authority to coordinate has recently been challenged by a group calling itself the Greater Pacific Coordination Council, which wants everything north of San Francisco and the area covered by the Central Valley Repeater Association. As the group's name implies, it wants jurisdiction over everything in the way of amateur relay stations operating off hilltops in California's Central Valley area.)

Then when you cross the Tehachapi Mountains, you get into Southern California, where 10 meters, 6 meters, 3/4 meters, and all bands above are the domain of the Southern California Repeater and Remote Base Association. Those are the fine fellows who absolutely refuse to publish a list of all activity on the UHF bands they coordinate because they consider everything and its uncle to be "private turf." Oh, they do list a smattering of supposedly "public-access" repeaters. (Does this mean that no license is required?) But what about the other 500–600 systems that pervade the Southern California UHF airwaves? Supposedly, they "do not exist" as far as the outside world is concerned.

Two meters and 1-1/4 meters each has its own coordination council, which operates on a by-band basis. Two meters is represented by the Two Meter Area Spectrum Management Association, while 1-1/4 meters is the domain of the 220 SMA. Unlike their UHF counterpart, neither of these groups is paranoid about letting the world know that these bands are utilized—in fact, very, very utilized. So much so, that it's virtually impossible to get a two-meter repeater channel pair anywhere in California—that is, from the current coordinators. (The South also has several splinter coordination groups, but like those in the North they have no meaningful public recognition. Three exist, all based on the demographic characteristics of their constituencies.)

Obviously, a good entrepreneur could really clean up in California! I can just picture the advertisements in all of the ham magazines:

California Hams!

Tired of waiting for a frequency for your new two-meter repeater? Tired of the NARC and TASMA runaround? The *73* Amateur Radio National Frequency Coordinator can get your repeater on the air. Send check or money order for $2,000 today. Frequencies now also available on every band for repeaters, remotes, digipeaters, and simpatches. We coordinate everything, everywhere if you will pay the fee!

Don't worry; you are not going to see this ad anywhere except in this hypothetical treatise. *73* is not about to get into repeater coordination! If it did, it would probably fall on my shoulders, and I have enough worries right now without taking on national frequency "speculation."

While we are on a roll, let's keep on going. Why just coordinate repeaters, remotes, and other relay systems? While we are at it, how about the low bands? Think of the bucks that could be made by forcing your coordination onto all of those 75-meter rag-chews and nets. How about selling discrete operating frequencies to DXpeditions, or better yet, to those multi-multis trying to make the contact from stateside? It's well-known that the DX crowd is the wealthiest part of ham radiodom. How much is a clear spot on the low end of 20 meters worth? Would someone pay $20,000, or maybe even $50,000 or more? And all those wealthy yachtsmen on 14.313 MHz busy conning naive stateside hams into breaking Part 97 rules by making business calls and business autopatches for them . . . well, if they can afford a $2,000,000 yacht and a $2,000 top-of-the-line radio, how about a "coordination fee" to them of say . . . $1,000 a year. If any hams can afford such a coordination fee, they can!

And we must not forget our ham satellites. If fees are "in order and legal," then why not permit AMSAT to "coordinate" everyone who uses one of the OSCAR birds? Currently, the cost of commercial time on a communications satellite such as Galaxy or Telstar is about $750 an hour, not counting the uplink and downlink facilities. Since we hams have our own uplinks and downlinks, we need to consider only satellite transponder time. Now, what true-blue, died-in-the-wool satellite fancier would not be willing to pay that pittance to AMSAT for the privilege of having his or her signal heard throughout the footprint of an OSCAR bird? And what a boon to AMSAT if they had several hundred thousand dollars a month coming into their coffers. New satellites would be going up on a regular basis. They could even have companies like RCA or Hughes build them!

The possibilities opened by the FCC permitting the collection of coordination fees are endless! You need only search your imagination to quickly become the richest ham in town.

So, while fees may seem innocent enough on the surface, they are far from that. In fact, I feel that permitting coordinators and councils to collect fees of any sort is to invite the kinds of problems that we hams are ill-prepared to cope with. I have nothing against repeater councils charging membership dues to those who wish to join such a group, as long as membership is on a voluntary basis. In fact, that has been a tradition down through the ages with any club or organization. There is a difference between charging an annual fee to those who wish voluntarily to join an organization and forcing someone to pay a specific fee for a service rendered. Coordinators and councils do not now sell frequencies, but given the legal right to collect fees for performing the coordination process, they soon would.

In Alabama, a $10 fee for initial coordination and $5 for any changes was proposed. Whether this fee will ever be initiated in the state is unknown. Also unknown is whether the FCC will act to close this loophole in its regulations to prevent the imposition of such fees by coordinators or coordination councils. As stated earlier, I oppose the collection of fees by frequency coordinators. In two decades of operation, the concept of voluntary coordination has worked because those involved were individually and collectively dedicated to preserving a sense of sanity on our VHF and UHF bands. Institution of fees will only commercialize amateur radio further and make buying a repeater channel pair as easy as buying a prefabricated repeater system itself. Is that what ham radio is all about?■

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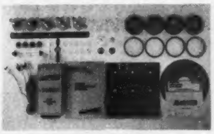

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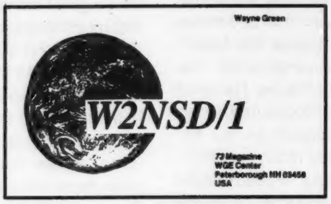

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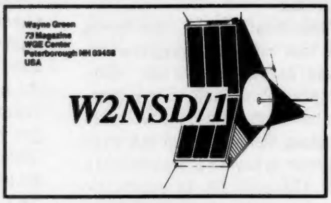

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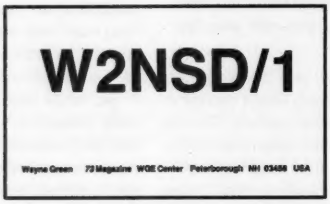

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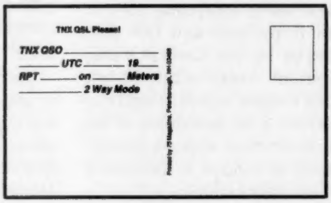

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FEEDBACK

In our continuing effort to present the best in amateur radio features and columns, we've decided to go directly to the source—you, the reader. Below, the articles and columns in this issue are assigned numbers. These numbers correspond to those on the "Feedback" card opposite this page. On the card, please check the box which honestly represents your opinion of each article or column.

"What's in it for me?" comes the cry from our faithful readers. Besides the knowledge that you're helping us find out what you like (and don't like), we'll draw one Feedback card each month and award the lucky winner a free one-year subscription (or extension) to *73*.

To save some money on stamps, why not fill out the Reader Service card, the Product Report card, and the Feedback card and put them in an envelope. Toss in a damning or praising letter to the editor while you're at it. You can also enter your QSL in our QSL of the Month contest. All for the low, low price of 22 cents!

Feedback#	Title
1	A Rotatable *What?*
2	HF Antennas: All Bands, All Wire
3	Watts My Line
4	Scaling the Wet Noodle
5	The Missing Link
6	Dishing It Out On 10 GHz
7	High and Dry
8	The Ramada Radiator
9	The Texas Tango Antenna
10	Trap An Amazon Aerial
11	The Lazy U Dipole
12	The 75m Laid-Back Quad
13	Kit Corner: Build A Two-Tube Vintage Receiver
14	CoCo's Compu-Charger
15	Review: ICOM IC-1271A
16	Review: Heath HO-5404
17	Above and Beyond
18	Barter 'N' Buy
19	Fun!
20	Ham Awards
21	Letters
22	Looking West
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Congratulations to **Don Burr AJ6X,** this month's winner of a one-year subscription.

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Reader Service: To receive more information on the products advertised in this issue of *73*, circle the appropriate number.

3696R

73 Magazine Product Report Card

Please rate any ham gear you're using from (0) poor to (9) superb.

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The Pitch: *73* wants to know what you want to read. Help us by voting on this month's features and columns—you'll find their numbers in the Feedback box on the page preceding this card.

The Payoff: Each month we'll draw a card at random. If yours is picked, you'll receive a one-year subscription (or extension) to *73*.

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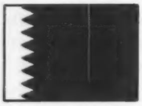
73 INTERNATIONAL

Just because I started this column as a result of visiting DX hams is no reason you shouldn't put in your 2¢ worth and let me know what DX news you find most interesting. My inclination is to have DX ops tell us what they think is interesting—how we can get permission to operate if we're fortunate enough to visit—any coming DXpeditions—what's doing with repeaters—things like that. What do YOU find most interesting? Since we have a world hobby, I think you'll be as interested as I in what is going on. If nothing else, it gives us something to talk about on the air which, from what I'm hearing these days, can't hurt.

—Wayne.



BAHRAIN

Ian Cable A92BW
Amateur Radio Association
Bahrain
PO Box 22381
Muharraq
Bahrain
Arabian Gulf

Welcome back to 73 International, Bahrain and A92BW, last seen in this column in June, 1983! We may expect to hear more from ARAB (Amateur Radio Association Bahrain) when something more happens, whenever that might be. As the following shows, it cannot be predicted with any accuracy.

Not much is happening in Bahrain. Some DX gets worked but there are no thoughts of DX operations. The 2m repeater functions on R6 European band plan and enjoys a small and somewhat infrequent following.

Visiting hams are welcome to contact ARAB for information, and we are also listed in the local telephone directory, yellow pages. There is absolutely *no chance* of visitors obtaining a license or even of operating from an already established station here.

We have had a QSL bureau here for the past 30 years—operating out of my personal mailbox for 25 of them. Third-party traffic is not permitted, and there are no special-activity prefixes likely to be aired for the balance of 1986. There is some activity via OSCAR 10 mode B and also HF band AMTOR.

The number of amateurs in Bahrain is smaller than it used to be as the expatriate population has fallen—there is a recession out here, too—but there is a growing awareness of the amateur radio hobby amongst the Bahrainis themselves, which is most welcome.

ECUADOR

Alberto Henriques Navarro
HC2HX
President, Guayaquil Radio Club
PO Box 5757
Guayaquil
Ecuador

MIDDLE OF THE WORLD

The first annual "Concurso International DX-HC Mitad del Mundo DX-HC" (International DX-HC Middle of the World Contest) has been announced by its sponsor, the GRC (Guayaquil Radio Club), for the purpose of strengthening "the friendship between the HC and the rest of the world's ham radio operators."

"El Ecuador abraza al mundo y el mundo al Ecuador," the announcement reads—Ecuador embraces the world, and the world embraces Ecuador. The contest will run for 48 continuous hours from 0000 UTC October 4 until 2359 UTC October 5—the first weekend in October will continue to be the days scheduled for this contest.

All amateurs are eligible to enter except the special HD stations and members of the GRC contest commission. Frequency: SSB, with the maximum power authorized for the ham's own station license. Call: "CQ HC Contest." Exchange: RS plus three digits (e.g., 59-001 to 59-999). Entry classes: single operator, 7-MHz band; single op, 14-MHz band; single op, both bands; and multi-op, both bands. Contacts on crossband are not permitted, and transmitting two or more signals at the same time, including cases of different bands, is not allowed.

Special Middle-of-the-World callsign stations: HD1GRC on the equator; HD0GRC, the Cayambe Volcano; HD7GRC in the Ecuadorian Amazon; and HD8GRC on Galapagos Island. Contact with these is worth 20 points for both HC and non-HC stations. Non-HC station contacts with HC stations are worth 10 points as are HC contacts with non-HC stations. Non-HC multipliers: the sum of the numerals of worked HC zones (only once and per band), so that the maximum multiplier for 7 MHz is 36, as is the maximum also for 14 MHz, since 1+2+3+4+5+6+7+8=36.

HC zones are:

HC1—Carchi, Imbabura, Pichincha
HC2—Guayas, Los Rios
HC3—El Oro, Loja
HC4—Manabi, Esmeraldas
HC5—Chimborazo, Canar, Azuay
HC6—Cotopaxi, Tungurahua, Bolivar
HC7—Ecuadorian Amazon
HC8—Galapagos Island

HC contacts with HC stations are worth 5 points; HC multiplier is the number of countries worked, according to the ARRL list. Only one contact per station per band can be counted. Total score is the sum of the contact points on each band times the multiplier for that band.

Summary sheet: Write in your declaration and signature to give evidence of following the contest rules; include callsign, full name, entry class, type of license, and address. Log sheets (separate logs for each band): band worked, date, UTC time of contact, call of station worked, signal report given and received, and summary of points and multiplier.

Summary and logs should be postmarked by December 31, 1986, and mailed with five IRCs to International DX-HC Middle of the World Contest, c/o Contest Manager, Guayaquil Radio Club, PO Box 5757, Guayaquil, Ecuador, South America.

A trophy and diploma will be awarded to non-HC first- and second-place winners in each entry category (a medal and diploma for each HC first- and second-place winner). Only one prize per station. Awards will be made to non-HC stations with more than 30 QSOs with HC stations and 3 or more with HD stations, and to HC stations with more than 60 QSOs, of which at least 30 must be with non-HC stations—and additionally for 7 MHz, there must have been contact with 3 HD stations, and for 14 MHz, with 1 HD station. There will be special WHC (worked all HC) certificates for every station participating in the contest that contacted at least 5 HC zones.

Disqualification: For violation of contest rules; for violation of country-of-origin rules for radio amateurs; for false statement in a report; and for duplicated claim credit on any one band in excess of 5% of the total.

NOTE: First prizes in non-HC categories will be melted granite medallions—reproductions of the "Jama Quaque culture" from Ecuador's Manabi province around 1500–2000 B.C., sculpted by Paul Palacios.

INDONESIA

Erlangga Suryadarma
YB0BZZ/V85BZ
ORARI National QSL Bureau
PO Box 96
Jakarta 10002
Indonesia

(Continuation of last month's report by YB0BZZ and Ben S. Samsu YB0EBS.)

As announced at the IARU Region III conference in New Zealand last November, ORARI (Organisasi Amatir Radio Indonesia) now has these plans:

1) To establish better organization throughout the country for the ORARI QSL and Awards Bureaus.

2) To establish a better and continuous publication of periodicals, magazines, and other printed material for members.

3) To establish training sessions for the promotion of international communications.

4) To issue a new ORARI awards program to encourage all members to participate in award-hunting nationally and/or internationally.

"Without question, amateur radio has a bright future for development and growth in Indonesia. With a government sympathetic to it—and especially the provincial governments which are very enthusiastic [because of amateur radio's services in times when communications are otherwise lacking]—amateur radio in In-

Uncle Ben says...

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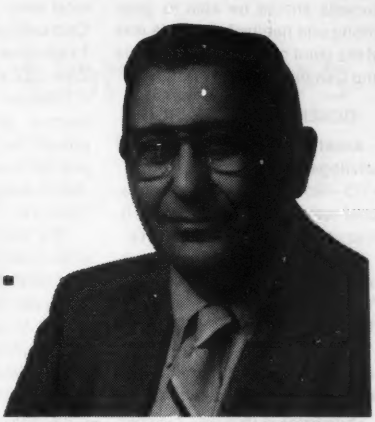

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donesia should be able to grow strong and heathy to become one of the giant radio societies in Asia and Oceania."

GENERAL INFORMATION

Amateur radio classes and privileges:

- YD—Novice—One-year license, local communications only, 10-Watt output, 80-meter band only.
- YC—General—Three-year license, national communications 75-Watt output, all bands except 20 meters.
- YB—Advance—Three-year license, international communications, 500-Watt output, all bands.

Obtaining a license: Foreigners should have a temporary residence or residence permit for Indonesia and be a national of a country having a reciprocal agreement. [As of a year ago: USA, UK, Canada, Australia, W. Germany, Netherlands, Sweden, Belgium, France, Argentina, and Finland.] Application may then be made with a "request to establish a station" using Form "D" and submitting it with copies of your residence permit, your valid amateur's license issued by your country, and your valid passport, and paying the annual fee of U.S. $7.50. Application should be made to the Directorate General of Post and Telecommunications through the *Daerah* (local, Provincial) level.

License class and privileges will be based on class of license possessed and will be issued for one year (renewable). A callsign prefix will be issued, in the range from AQA to AZZ. NOTE: Operation of an existing station by a transmitting guest *is strictly prohibited.*

New callsigns: When the YD to YB prefixes are fully allocated, a new combination as-yet not announced will be added. The following are in the conceptual stage: YE with one alphabet suffix will be issued for domestic special callsigns for field days, contests, experimental stations, national sports events, etc. A two-digit combination will be used for the two national events: ORARI anniversaries and the Republic of Indonesia Anniversary of the Independence. Secondary prefixes of 7A–7I and 8A–8I will be used only for international events such as World Communications Year, Amateur Radio Day (April 18), United Nations Day, etc.

General operation: Club stations on the *Lokal* (District) level are encouraged to promote activity for communications training—local nets, DXing, seminars, etc. Club callsigns are YB and YC prefixed, plus call area digit, with ZAA–ZZZ suffixes.

Repeater networks on experimental bases have been approved by the government and permits issued at the provincial or district level for supervision by the Province.

"By law, all members should participate in monitoring the amateur band and report any interference, discrepancies, or any activity not in accordance with the general rules of amateur radio." Implementation of this law produced good effects for a period of time, but a certain amount of "spectrum anarchy" resulted from the simultaneous (a) influx of VHF/UHF equipment, (b) governmental approval of Citizens Band use, and (c) the prevailing difficulties or nonexistence of public communications facilities. Involved were illegal importations of equipment, modifications of equipment for allband and wideband use which threatened creation of "a destructive situation for [amateurs] in a developing country since it will be utilized [legally] by commercial and public service parties which can occupy both parts of the amateurs' bands and [the other bands]." This presents "a great task for ORARI"—in education, supervision, and also "to implement strict disciplinary action for members" involved in illegal activities.

ORARI [it was reported at the IARU conference] has been making a special effort to "patrol" the bands, and apologizes for any disturbances which "were exported from Indonesia." IARU-member countries, Region III, were invited to file complaints of any such disturbances, "so that ORARI may forward [them] to the government for further investigations."

To be continued next month.

INDIA

Miss R. Subha
3 Thiru-Vi-Ka Road
P.B. No. 725
Madras 600 006
India

THE SEARCH FOR AN APEX BODY

Indian hams, despite attempts over a decade, have not succeeded in making their government accept any one body as representing their interests.

The Amateur Radio Society of India (ARSI) at New Delhi enjoyed a monopoly as the only country-wide organisation for over 20 years, but it specialised only in needling the WPC (Wireless Planning and Coordinating—a Wing of the Ministry of Communications), which is our licencing body, corresponding to the FCC in the U.S. It did not establish the type of healthy rapport that most IARU member societies enjoy with their governments. As the membership grew, this society became a hotbed of controversy, leading to a split and the establishment of the Radio and Electronics Society of India (RESI) at Bombay.

While refusing to recognise RESI as the sole representative of the amateurs (although it had on its rolls a majority of the licenced amateurs of the country), WPC suggested that it would recognize a federation of the various societies. However, when the Federation of Amateur Radio Societies of India (FARSI) was formed by all the societies except one (ARSI, naturally) and asked for recognition, WPC resiled and began to talk to *all* comers. This encouraged a number of aspiring leaders to claim to better represent the interests of amateurs than both FARSI and ARSI.

One of these was a small society based in Hyderabad, which, with some patronage from the ruling political party, sponsored a National Institute of Amateur Radio (NIAR). It was sanctioned by being awarded a grant of over ten million rupees [in 1984, slightly under a million U.S. dollars], a fourth of which was paid out, with the avowed purpose of promoting amateur radio in India. After two years, the government decided that it had waited long enough for results and began looking around for a new "apex" body upon which to bestow its financial favours.

The concerned government departments sponsored an unofficial seminar on April 12 to identify a new apex body. The outcome is reported to be a synthesised body called the Indian Council of Radio Amateurs, made up of representatives of the Department of Electronics, WPC, FARSI, NIAR, and five amateurs, VU2CPJ, VU2SDN, VU2KAJ, VU2KV, and VU2BSN. The objective of this apex body is stated to be limited to acting as a link between the amateurs and the government, and as a channel for disbursing the government's monetary benevolence.

To what extent this body will succeed in promoting amateur radio will be revealed by the efflux of time. Meanwhile, FARSI continues to represent over 60 societies, run a QSL Bureau, and publish its monthly journal, *Radio*. All this leads the ham-in-the-street to wonder whether an apex body can be imposed from above, by the government's fiat, or whether it should be built from grass roots by the support of its members.

REPUBLIC OF KOREA

Jongho, Yi HL1AFP
#1691–19 Bongcheon 6 Dong
Ga–Gu, Seoul 151
Korea

We welcome with pleasure Lee HL1AFP, our new correspondent for the Republic of Korea (South Korea). Now we will be able to catch up with developments since April of 1985, when we last heard from "the land of the morning calm." He writes us, "My English is very poor, I believe you will be re-editting very nice sentence, I really hope so." No way should that sentence be changed: It says exactly what it means with all the clarity one could desire and with more clarity than much that is written today in technically correct English. Lee's phone number is 884-9526 if you are in Seoul; dial 02 first if you are in Korea but not in Seoul; dial 82, then 02, then his number if you are direct dialing from abroad.

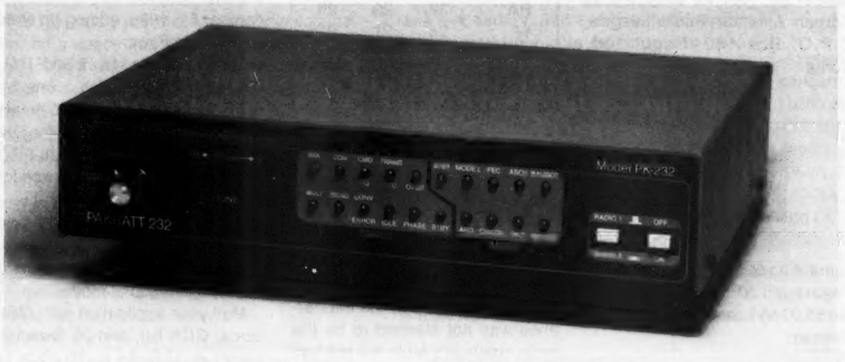
ASIAN GAMES CALL

My first news for you from the land of morning calm, Korea, is the special callsign, 6K86AG, for the 10th Asian Games to be in Seoul. We will use this call for 35 days, from 1st September to 5th October. We will be located at the KARL shack (Korean Amateur Radio League) from 1st to 19th September and at the main stadium for the games for the rest of the period.

We plan a Ham Press Center at the stadium and hope to be able to be helpful for foreign participants in the Asian Games at 6K86AG. I will be an operator there. Korean hams will be able to use 86 in their

RS-232 Compatible

Goodbye to Packet Only Controllers



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Late last year AEA broke new ground by introducing the first five mode amateur radio computer interface with Morse, Baudot, ASCII, AMTOR, and Packet...the PK-64. Now AEA has another breakthrough....the PK-232.

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The PK-232 makes any RS-232 compatible computer or terminal the complete Amateur digital operating position. By using a simple terminal program any computer with a standard RS-232 I/O can connect directly to the PK-232 and be ready for operation in minutes. The internal autobaud program allows 300, 1200, 2400, 4800, and 9600 baud communication between the computer and the PK-232. All decoding, signal processing, and protocol software, for Morse, Baudot, ASCII, AMTOR, and Packet, is on ROM in the PK-232. The PK-232 is a Z-80A based system and has hardware HDLC using the Zilog 8530 SCC. The internal modem of the PK-232 can transmit Packet at baud rates of 300 and 1200, with the option of using an external modem for 2400, 4800, and 9600 baud.

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With twenty-one front panel indicators it's easy to monitor operation. Separate indicators show operating mode, current operating status, and data carrier detect. A front panel switch allows selection of two separate radio connectors, no more switching cables when jumping from HF to VHF. The front panel threshold control adjusts squelch for both HF and VHF. The AEA standard discriminator style tuning indicator makes tuning easy in any mode and on any band.

Serious VHF/HF/CW Modem

The PK-232 also includes a no compromise VHF/HF/CW modem with an eight pole bandpass filter followed by a limiter discriminator with automatic threshold correction. Once the operating mode is selected the modem automatically selects the proper bandwidth, 200 hz for CW, 450 Hz for HF, or 2600 Hz for VHF. Transmitter tones are low distortion sine wave phase continuiuous AFSK. The PK-232 will receive wide shift RTTY signals, but only transmits 200 Hz shift on HF.

Prices and specifications subject to change without notice or obligation

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AG PREFIX LIST

A4, A5, A6, A7, A9, AP, BY, DU, EP, HM, HS, HZ, JA, JT, JY, OD, S2, V8, VS6, VU, XV, XW, XZ, YA, YB, YI, YK, 4S, 4W, 70, 8Q, 9K, 9M, 9N, 9V, and HL.

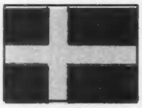
calls for the special callsign period—I can use HL86AFP, for example.

ASIAN GAMES AWARD

Available to all hams/SWLs worldwide, for the period of the Asian Games: HL-class award for those making contacts (heard) with (from) ten HL stations including at least one HL1 (Seoul) station; DX-class award for those who made contacts (heard) with (from) ten countries participating in the Asian Games, including HL, but contact with a station in one's own country will NOT count.

The commemorative station, 6K86AG, or any one HL86--- station and the Commemorative QSL cards will count as equivalent to five HL stations or five participating-country stations, whichever is applicable. (See box for prefixes of participating countries.)

Send Won 2,000, US $4, or 10 IRCs with GCR before December 31, 1986 (for HLs) or before September 20, 1987 for all others, to Korean Amateur Radio League, C.P.O. Box 162, Seoul 100, Korea.



SWEDEN

Rune Wande SM0COP
Frejavagen 10
S-155 00 Nykvarn
Sweden

RFI CAUSES POWER RESTRICTIONS

Interference problems caused by the lack of rf-immunity in home entertainment equipment is a major threat to ham radio. A recent RFI case here in Sweden indicates that the licensing authority is changing attitudes towards the radio amateur.

Up to the beginning of the 1970s, interference (TVI, BCI, RFI) was always blamed on the ham operator. During the 1970s, a slight change developed: If a device was not a radio or TV receiver but just an amplifier (tape recorder, stereo amplifier, telephone, and the like), the interference was not claimed to be the radio amateur's fault. He still had to cope with the neighborhood problems, though. In some cases the manufacturer of home entertainment equipment helped out, supplying and even installing filters for better rf rejection.

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Dr. "S", WA4DRV

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	1983	1984	1985
DL	136	177	137
LA	67	81	82
OZ	34	37	32
PA	32	20	26
W	24	21	21
G	17	22	21
Others	33	44	17

Table 1.

In fact, it is improper to talk about interference when the fault is in the unit itself, due to poor design. However, everybody talks about interference caused by the ham transmitter although the problem is produced within the interfered unit.

Early this year, a Swedish ham had heavy power restrictions imposed upon him because of interference in video recorders when he was transmitting. Video recorders are our new problem area, and you can never know when your neighbor is watching. On the 80-meter band, this ham is allowed a maximum output of 0.3 Watts (300 milliwatts)! Certainly there are QRPp fanatics who use such low power at times, but they do so on their own. To be forced to close down ham radio activity due to deficiently designed video recorders is outrageous and a threat against ham radio entirely.

This is a worldwide problem, and I would appreciate very much to receive any input on how this is handled in other countries. I am a member of the EMC working group in our league SSA.

THE FRO AWARD

The Swedish voluntary radio organization, FRO (Frivilliga Radio Organisationen), is celebrating its 40th anniversary in 1986. FRO is administered by the military service but most members are nonmilitary. The Swedish military club stations are indicated by the prefix SL, and all FRO stations have in addition the letter Z as the first suffix letter, e.g., SL0ZG, SL2ZYK; then there are the special stations: SL-FRO.

The FRO-40 Award may be won through contacts with FRO stations between May 24 and December 31, 1986, adding up to 40 points, as follows:

- Contacts with 7S1FRO, 7S2FRO, 7S3FRO (etc., one for each call area) are worth 5 points for Europeans, 10 points for DX; Contacts with SL-Z— or SL-FRO stations are worth 1 point each for Europeans, 3 for DX.
- All bands, including 10, 18, and 24 MHz are valid.
- Count each station once on each band, regardless of mode.

Mail your application with QSL cards, GCR list, and 30 Swedish kroner or U.S. $4 or 10 IRCs to FRO, Riddargatan 13, S-114 51 Stockholm, Sweden.

VISITOR STATISTICS

We hams always like to bring our radios with us wherever we travel. Thanks to reciprocal licensing agreements between various licensing authorities, we are able to obtain short-term visitor licenses in many countries. Sweden, however, does not require a mutual agreement for issuing a visitor license here. In European countries, these tickets usually are issued for three months and a fee is charged. In many cases, an application should be sent three months in advance. Hopefully, all this will soon be simplified by the so-called CEPT license that is supposed to be valid in most European countries without separate applications. Some countries, like Norway, Denmark, and West Germany, are in the process of accepting the CEPT concept.

During the last three years, Sweden has issued visitor licenses to hams from some 25 countries (see Table 1).

SM ON TOP BAND?

A handful of Swedish hams have been very successful on the 1.8-MHz band despite the restrictions we have, i.e., narrow band 1830–1845 kHz and only 10 Watts input. However, good antennas have helped. If you want to work Sweden on the Top Band, get in touch with Jan Skoldenberg SM5DGA, Backv. 13, S–752 52 Uppsala, Sweden. Jan is very active on that band and has current information on the others who also have good capabilities for 160 meters. Please be sure to enclose an SAE and IRCs if you wish him to send you any information.■

HAM HELP

We are happy to provide Ham Help listings free, on a space-available basis. We are not happy when we have to take time from other duties to decipher cryptic notes scrawled illegibly on dog-eared postcards or odd-sized scraps of paper. Please type or print your request (neatly!, double-spaced, on an 8-1/2 x 11 sheet of paper and use upper- and lowercase letters where appropriate). Also, please make a 1 look like a 1 not an l—which could be an el or an eye, and so on. Hard as it may be to believe, we are not familiar with every piece of equipment ever manufactured on Earth! Thanks for your cooperation.

I would like to purchase a Fisher Model MPX-20 externally powered 4-tube multiplex adapter or a substitute for same. Will pay any reasonable price and expenses. Phone only if you have one: (216)-481-0274.

Herb Schleman KA8AZW
1910 Beverly Hills Drive
Euclid OH 44117

I need any information (schematics, manual, etc.) for the following frequency counter: BOHSEI Frequency Counter, M 7505, 10 KHz–30 MHz, Ebina Electronics Corp. Will pay any costs or copy and return.

Robert Carson Jr.
Box 364
Smithfield OH 43948

I would like to obtain the following Teletype bulletins: 120B, 252B, 254B, and 1044B.

C. T. Huth
229 Melmore St.
Tiffin OH 44883

Can anyone help me get a copy or photocopy of the owner's or service manual for my Hallicrafters S-120 shortwave receiver? Please write and let me know the cost before sending. Any help will be appreciated.

Steve Guelzo
318 Oak St.
Elgin IL 60120

I require service information for a pocket-sized VHF transceiver, model TR1007 by Rank Telecommunications, and also for a CHA Canadian Motorola VHF receiver base station. Any help is appreciated.

Errol May
R1 Lasalette
Ontario N0E 1H0 Canada

I need a schematic and/or owner's manual for a Dycomm 2-meter amplifier.

Karl Steinbach V.M.D.
PO Box 28
Harborton VA 23389

I need a manual and schematic for a Drake R-4, serial #1526. I will pay for shipping and/or reproduction. Let me know what you have.

Gary Mitchelson
295 I Snow Cap Court
Glen Burnie MD 21061

Please help me rehabilitate two CB amplifiers for use on 10 meters. I need schematics, manuals, or first-hand accounts on how to accomplish this. The two amps are:

The Squire 125, Electronics Unlimited, Lebanon, Tenn. (12 V dc) and

Marko XB-100, Cobra CB Radios (110 V ac).

I'm willing to pay reasonable costs for copying information on the above, or you can send material to me and I'll copy and return it.

Mel Riffe WD8NNL
4908 Western Rd.
Flint MI 48506

I need manuals, schematics, or information concerning a Hammarlund HQ-110 receiver, Hallicrafters S-40-B and S-38-A, Crown SX-711 tape recorder, and Crown International two-track tape recorder circa early '60s. In return, I have manuals for Hammarlund HQ-140-XA, Ampex 403 tape recorder (early '50s), and CQ "Command Sets" manual. Will copy sections you need.

Doug Walker
Route 2 Box 16
Tylertown MS 39667

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NEVER SAY DIE

from page 84

bring you $20 for a hundred readers.

As I mentioned a couple months ago, if I were a club looking for a newsletter editor, I'd start by finding out who has a Macintosh. The likelihood is that someone will have one . . . unless your club has been particularly nasty about getting youngsters to join. Old fogies are seldom Macintoshers. Even a C-64 can do the job, and I know you've got a few of those spread around the club.

You can get members with computers to zip in their copy via the club two-meter repeater . . . or by modem over the land line. You want to get reports into the newsletter on what DX your DX fanatics have worked recently. It's no good working it if you can't brag about it. You'll want a report on recent contests. Certificate hunters can brag on their latest wallpaper.

If anyone has sprung for the newest in ham gear, get 'em to write about it. You know they're busting to, if only you'll ask. And get 'em to bring it to the next club meeting so they can bask in the admiration of the less fortunate.

You'll want a report on slow-scan doings . . . what's new in RTTY countries . . . repeater news of new stations and channel changes. Has anyone made an interesting trip and brought back some slides or videos? I'm certainly not the only ham who gets off to interesting places.

Bermuda, For Instance . . .

In May I got over to Bermuda for a week for a President's Association conference. I had visions of basking on the beach . . . even took my suntan lotion, swim fins, mask, and Nikonos camera. The stinkers had sessions from 8 a.m. until around 7:30 p.m. almost every day! I came back as lilly white as I'd left. But I did get together with the VP9ers one night when they happened to have a club meeting. What a great bunch of hams! The .94 repeater covers the island so well I was even able to make contacts while riding in a taxi from the airport.

If you write ahead, it's easy to get a temporary operating permit, so W2NSD/VP9 hit the pavement running, HT in hand. You know, if you make a serious effort during the yearly Bermuda contest, you can win a trip to Bermuda to get your certificate! The club gets stations set up in every one of the nine Parishes and offers certificates if you contact all of 'em.

Bermuda is only an hour and a half flight from the East Coast, so you might start thinking in terms of giving it a try for your next vacation. The main (and almost only) industry is tourism, so you're going to have a good time. There are hotels and restaurants that cater to the rich, but there are plenty for the rest of us, too. I'm about as chintzy as they come, so I naturally seek out the better bargains. Sherry and I found a delightful restaurant on Front Street—it not only provided the best meal we had on the island, it was one of the most reasonable . . . the Longtail Restaurant. We were disappointed by the highly touted Green House at the Sonesta Hotel, Tio Pepe's, and Henry VIII.

You get around on Bermuda by moped or scooter. Since I've got a Yamaha scooter of my own, I went for the scooter. The speed limit is 20 mph for the island, but you have to go more like 30 to keep up with the taxis. The roads are all narrow, few with any shoulders . . . unless you call a ten-foot high sandstone wall a shoulder. Being a British island, the traffic is on the wrong side of the road, adding to the confusion. But the locals are used to thousands of mopeds and scooters in the hands of visitors, so they give the red license plates a wide berth and expect the worst at any intersection. There are surprisingly few accidents.

They don't have rental cars, so you either get around by taxi or by scooter. I preferred the freedom of the scooter, so Sherry and I covered the entire island with her clinging to my back. We did hit one short rainstorm. I just had on a shirt, so I got wet, but she didn't. I zipped under a big tree and waited a few minutes and the sun was out again and I quickly dried off.

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FRG-9600
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• 60 MHZ-905 MHZ Continuous

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The Program Chairman

Oh yes, I was writing about clubs, so let's get back to the program chairman's job again. You want action at the meetings. Whatever you do, don't let business meetings intrude on the fun. Business meetings are not fun. No, I don't care how involved the members seem to get, if you allow business to take much time, you're going to quickly thin out your club.

Part of the program is the show and tell of DXers with their silly DX QSL cards. Part is the contesters telling about an upcoming contest or how they did in a recent one. Get 'em to bring in their award certificates and show 'em. The certificate hunters will also oblige with this. How about a short slide show by your SSTV member, showing some recent DX he's worked? Find out what special interests your members have and keep after them to tell what they've done lately. This will spur them on to more and more activity. It'll also get other members interested in joining the fun.

Do you have a weekly club meeting over the repeater? This is where you can line up the talent for the next meeting. This is where you can find out who has been doing what and get them all set to show and tell at the next meeting.

This repeater meeting will help keep interest in the club high. It'll also make it possible for you to have special meetings on short notice. This also helps keep club interest high. In this case, I recommend you drop cards to every ham industry firm asking 'em to give you a call if a key person from the firm is going to be in your area in the future. Tell 'em you'd love to call a special meeting just to meet them and find out about their products.

I know I get around the country a good deal, but I don't usually think in terms of the local clubs arranging a special meeting for me. So I sit in a hotel room, wasting my time writing editorials or catching up on my reading. If I knew ahead of time the name of the club president or program chairman, I'd be able to give a call and see if a special club meeting could be arranged where I could meet everyone and give a talk. I'm ready, day or night, to talk . . . at length. I once managed six hours of talking in one day while visiting South Africa . . . giving talks for television, computer professionals, computer hobbyists, entrepreneurs, and hams. Whew!

So I'd suggest you plan to be able to gather ad hoc club meetings to fit the schedules of ham industry luminaries rather than trying to make do with just the few who are near enough to fit into your regular schedule. Between your club newsletter and your weekly repeater meeting, you should be able to get the word around and provide good turnouts.

Unless the ham industry people know you exist and are interested in them visiting your club, they'll get to your area on a business trip and you'll miss 'em. Tell you what, if you'll send me the name of whom to contact and the phone number, I'll run a quarterly list in *73* of clubs anxious to organize special ad hoc meetings for industry people. Let me know about how many reasonably live bodies you think you can muster on relatively short notice.

I happen to know the industry people do get around because every now and then they go as far afield as Peterborough. (You know, you could do worse yourself the next time you're vacationing in New Hampshire. Bring your QSL card and post it in the *73* offices. The offices are actually in Hancock, just north of Peterborough. When you call, we'll tell you how to find us.)

If you have someone who can act as a liason for visiting firemen . . . someone who doesn't get unelected after a few months . . . that's the best name to send me. Send it to Ad Hoc, *73* Magazine, WGE Center, Peterborough NH 03458. If you mark it to my attention, it could get lost for weeks while I'm off on a trip. So far this year I've visited Denver, Aspen, Miami, Orlando, Washington, Columbus, Dayton, Atlanta, Mobile, Tampa, Chicago, Dallas, New York, and Bermuda. Later this year I expect to be in Seattle, Vancouver, Vegas, San Diego, Quito, Lima, La Paz, Rio, Tokyo, Seoul, Taipei, Hong Kong, Kota Kinabalu, Bandar Seri Begawan, Kuching, Kuala Lumpur, Atlanta, San Francisco, Miami, and so on.

How about club mini-flea markets? Get that ham gear off the shelf . . . out of the drawer . . . out of the attic . . . out of the cellar. Get it to someone who can have fun with it. Have you tried a flea-market table as part of your club meetings? It's a way to get some cash for almost anything. You might want the club to get a 10% commission on sales to build up the club treasury.

A *73* Table

Another way to scrounge some cash is to convince club members they'll enjoy reading *73*. We have a special club deal, if you're interested. Hey, none of this making up an instant club to get a discount, okay? I want to see a membership list, a club newsletter, or something. Write to Club Deal, *73* Magazine for the gory details. If you're going to have a hamfest, big flea market, auction, picnic, or something, you could do worse than run a *73* table.

I have a lot more ideas for you on getting your club into gear. But don't make me do all the work . . . if you try something and it's successful, drop *73* a line so we can pass your idea along to help other clubs grow.

ADS IN PERSPECTIVE

For some reason many hams have the feeling that selling things to hams is kind of tainted. Part of this probably stems from the ham urge to build our own equipment, which results in a subconscious annoyance when commercial ham gear is far better and cheaper than we can build. It perhaps generates an inferiority feeling which expresses itself subtly as envy and jealousy.

Then, too, there is the teacher's syndrome—we're nonprofit, so anyone selling things to us for a profit is taking advantage of poor, downtrodden us. This is the justification used by teachers for mimeographing and photocopying copyrighted books and making illegal copies of copyrighted software. It's okay for me to steal because I'm giving it to the poor—I'm Robin Hood. There's always been this feeling that it's okay to steal from the rich—they're different. After all, they've got plenty, so what's it hurt?

In the ham industry we don't have very many rich people. We have a hobby that has been running down for 23 years—where the average age of the ham is now 56—where newcomers dropped 8.5% last year and 7.9% the year before—a smaller and smaller market as more hams go into retirement and have to find a way to live on Social Security . . . which often means no more ham gear.

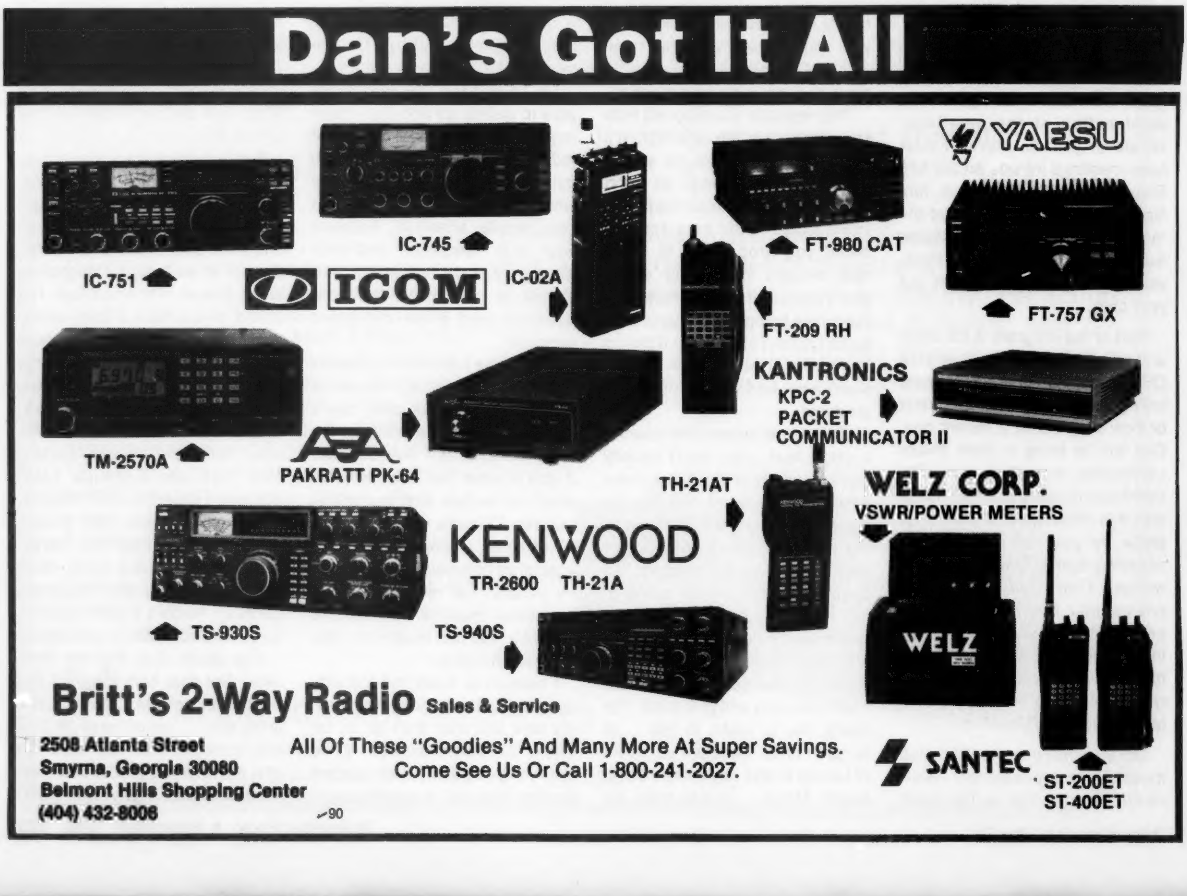
What on earth gets into someone to get into such a dying market? Of course the big firms today are Japanese. In Japan amateur radio is a huge hobby. They've licensed about five times as many hams as we have and there are ham clubs in every school in Japan turning out tens of thousands of young, eager hams. Their ham magazines are four times the size of ours. It's only logical for this to be the amateur radio capital of the world now.

Though the big firms are all Japanese, we still see hundreds of small firms—American firms—what about these? Most of 'em got started when a ham built something different. Ham friends then say why don't you make that and sell it? Often the ham will get together with a friend and decide to give it a try. They are amazed at how cheap parts are when you buy them in bulk—nothing at all like the prices for parts on a card in a Radio Shack—about the only parts source left these days for most of us, now that all the parts stores are out of business.

So two (sometimes three) hams start a company making something for packet radio, for repeaters, for slow scan, maybe an antenna. They run ads in *QST* because that's the biggest magazine. They get a few orders and requests for literature. They don't know a blessed thing about advertising, so their ads are lousy and their literature worse. They limp along, getting enough orders to keep in business. They try ads in the other ham magazines and find that some do better than *QST* and some do worse—a whole lot worse.

I've been studying advertising ever since I took a course in it at the Advertising Club of New York over 20 years ago. That was one of the most valuable courses I've ever taken, yet I know of no college with anything remotely like it—one of the reasons I'd like to get into the college business.

It turns out the basic rules of advertising are fairly simple. You also discover that surprisingly few people working in advertising know what the hell they are doing. Unfortunately, like learning almost any other skill, you find the normal human reflexes are almost invariably wrong. If you try to learn to ski by doing what comes naturally, you'll never make it. Ditto horseback riding, and so on.



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So, since virtually no one in the ham business has ever learned the fundamentals of advertising, and since most ads in ham magazines are written by these folk, guess what? I'm not picking on ham manufacturers and dealers; we have the same situation in the computer industry.

The obvious move is to turn to a professional, right? Har de har. Yes, there are a few ad agencies that know what they are doing. Some are doing a beautiful job of advertising for their clients. But sadly, there are more agencies that are turning out ads that aren't selling the product. These often are highly paid agencies, too.

A chap I know hired a manager to run his new company. The manager hired on a very expensive ad agency. The ads were simply awful and, surprise, the product didn't sell worth beans. So the chap fired the manager, did the ads himself, got the product moving, and sold the firm for several million dollars. The new owner, despite warnings, went right back to the expensive agency and quickly brought sales to a halt. I tried to talk with the pompous blatherskite from the agency, but found no one really at home.

I'd like to give an advertising seminar for the ham industry, but I don't know of any place to get 'em together. I dropped a note to every firm in the industry suggesting meeting a day early at Dayton and got just one response. When you consider that the difference between an effective ad and a poor one can be well over a ten times difference in sales, I wonder.

One of the services I'm planning for *73* will be a reader vote on the ads. As soon as I can set up a computerized system for tallying the results, I'll have a way for you to tell the *73* advertisers which ads you find most interesting—and which are turkeys.

I don't have to explain the function of advertising in a ham magazine do I? The ham magazines are about the only way the ham industry can let you know what they're selling. Most of us are interested in buying new ham gear now and then. It's fun to get something new and put it on the air.

Half the income for ham magazines comes from ads, so they're critically important to a magazine's health. Very few hams are interested in paying double the current subscription prices for their magazines. In *73* my rule of thumb is that every two ad pages allows me to print another three pages of text—so the more ads, the fatter the magazine. We make our profits with our other magazines, so we can afford to run *73* at no profit. Remember, the main reason I took back *73* was to use it to get amateur radio growing again. I already have more than enough to do in what little is left of my life without *73*.

When we get amateur radio into a strong growth mode, there will be many opportunities for hams to start new enterpreneurial firms and do very well. During the computer growth years, we saw hundreds upon hundreds of new millionaires. Some kept it, some blew it. Some did incredibly well.

For those few of you who don't think making a lot of money is a terrible thing to do, there have never been so many opportunities to get rich as we have today—and hams have an edge. I'll be writing more about this if I get any encouragement. My past experience has been that most hams don't want to be bothered. Many feel so defeated that they can't even imagine gambling on something new, even in their spare time.

Of course I understand that many hams have no spare time. When they're not sitting there with an 807 in hand, maintaining their expertise with baseball, football, or basketball statistics, they are rag-chewing on 75m, grumbling about the QRM. If the shoe fits . . . remember that I started out with nothing but the guts to put everything I owned into printing the first issue of *73*. I worked very hard for years and went through several major traumas, seeing little success for the first 15 years. No complaints, I published *73* because I enjoyed it and the hundreds of hundred-hour weeks were both fun and agony.

Older hams may be starting to think in terms of some sort of business to run in their retirement. It's better than trying to live on Social Security and eating cat food. Some like the idea of a shop—some prefer a mail-order business since it offers much more freedom. There is no end to the potential small mail-order businesses, so if you're interested in that I'll try to write about it occasionally. It's up to you. If you prefer me to write about the awful band conditions all the time, okay.

If you do decide to go into business, for heaven's sake learn all you can about advertising—you're going to need the best ads you can get no matter your business.■

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MODEL MFJ-941D

$99.95 MFJ-941D

MFJ's fastest selling tuner packs in plenty of new features!
- **New Styling!** Brushed aluminum front. All metal cabinet.
- **New SWR/Wattmeter!** More accurate. Switch selectable 300/30 watt ranges. Read forward/reflected power.
- **New Antenna Switch!** Front panel mounted. Select 2 coax lines, direct or through tuner, random wire/balanced line or tuner bypass for dummy load.
- **New airwound inductor!** Larger more efficient 12 position airwound inductor gives lower losses and more watts out. Run up to 300 watts RF power output. Matches everything from 1.8 to 30 MHz: dipoles, inverted vee, random wires, verticals, mobile whips, beams, balanced and coax lines. Built-in 4:1 balun for balanced lines. 1000V capacitor spacing. Black. 11x3x7 inches. Works with all solid state or tube rigs. Easy to use, anywhere.

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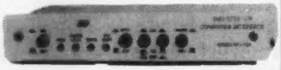

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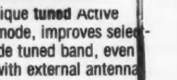

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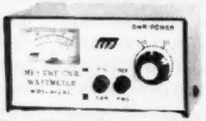
VHF SWR/WATTMETER

MFJ-812 **$29.95**



Low cost VHF SWR/ Wattmeter! Read SWR (14 to 170 MHz) and forward/ reflected power at 2 meters. Has 30 and 300 watts scales. Also read relative field strength. 4x2x3 in.

1 KW DUMMY LOAD

MFJ-250 **$39.95**

Tune up fast, extend life of finals, reduce QRM! Rated 1KW CW or 2KW PEP for 10 minutes. Half rating for 20 minutes, continuous at 200 W CW, 400 W PEP. VSWR under 1.2 to 30 MHz, 1.5 to 300 MHz. Oil contains no PCB. 50 ohm non-inductive resistor. Safety vent. Carrying handle. 7½x6¾ in.

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Switch to 24 hour UTC or 12 hour format! Battery backup maintains time during power outage. ID timer alerts every 9 minutes after reset. Red LED .6 inch digits. Synchronizable with WWV. Alarm with snooze function. Minute set, hour set switches. Time set switch prevents mis-setting. Power out, alarm on indicators. Gray and black cabinet. 5x2x 3 inches. 110 VAC, 60 Hz.

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MFJ TUNERS

This may be the world's most popular 3 KW roller inductor tuner because it's small, compact, reliable, matches virtually everything and gives you SWR/Wattmeter, antenna switch, dummy load and balun — all at a great price!

Meet "Versa Tuner V". It has all the features you asked for, including the new smaller size to match new smaller rigs-only 10¾"Wx4½"Hx14 7/8"D.

Matches coax, balanced lines, random wires—1.8 to 30 MHz. 3 KW PEP —the power rating you won't outgrow (250pf-6KV caps).

Roller inductor with a 3-digit turns counter plus a spinner knob for precise inductance control to get that SWR down to minimum every time.

Built-in 300 watt, 50 ohm dummy load, built-in 4:1 ferrite balun.

MFJ-989 **$329.95**

Accurate meter reads SWR plus forward and reflected power in 2 ranges (200 and 2000 watts). Meter light requires 12 VDC. Optional AC adapter, MFJ-1312 is available for $9.95.

6 position antenna switch (2 coax lines, through tuner or direct, random/balanced line or dummy load). SO-239 connectors, ceramic feed-throughs, binding post grounds.

Deluxe aluminum low-profile cabinet with sub-chassis for RFI protection, black finish, black front panel with raised letters, tilt bail.

MFJ's Fastest Selling TUNER

MFJ-941D **$99.95**

MFJ's fastest selling tuner packs in plenty of new features. New styling! Brushed aluminum front. All metal cabinet. **New SWR/Wattmeter!** More accurate. Switch selectable 300/30 watt ranges. Read forward/reflected power.

New antenna switch! Front panel mounted. Select 2 coax lines, direct or through tuner, random wire/balanced line or tuner bypass for dummy load.

New airwound inductor! Larger more efficient 12 position airwound inductor gives lower losses and more watts out. Run up to 300 RF power output.

Matches everything from 2.8 to 30 MHz! dipoles, inverted vee, random wires, verticals, mobile whips, beams, balanced and coax lines.

Built-in 4:2 balun for balanced lines. 1000 V capacitor spacing. Black. 11 x 3 x 7 inches. Works with all solid state or tube rigs. Easy to use anywhere.

MFJ's 1.5 KW VERSA TUNER III

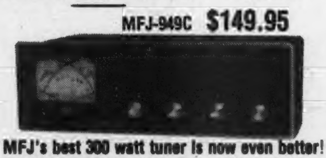
MFJ-962 **$229.95**

Run up to 1.5 KW PEP and match any feedline continuously from 1.8 to 30 MHz: coax, balanced line or random wire.

Built-in SWR/Wattmeter has 2000 and 200 watt ranges, forward and reflected power. 2% meter movement. 6 position antenna switch handles 2 coax lines (direct or through tuner), wire and balanced lines. 4:1 balun 250 pf 6 KV variable capacitors. 12 position inductors. Ceramic rotary switch. All metal black cabinet and panel gives RFI protection, rigid construction and sleek styling. Flip stand tilts tuner for easy viewing. 5 x 14 x 14 in.

MFJ's Best VERSA TUNER

MFJ-949C **$149.95**



MFJ's best 300 watt tuner is now even better! The MFJ-949C all-in-one Deluxe Versa Tuner II gives you a tuner, cross-needle SWR/Wattmeter, dummy load, antenna switch and balun in a new compact cabinet. You get quality conveniences and a clutter-free shack at a super price.

A new cross-needle SWR/Wattmeter gives you SWR, forward and reflected power—all at a single glance. SWR is automatically computed with no controls to set. Has 30 and 300 watt scale on easy-to-read 2 color lighted meter (needs 12 V).

A handsome new black brushed aluminum cabinet matches all the new rigs. Its compact size (10 x 3 x 7 inches) takes only a little room.

You can run full transceiver power output—up to 300 watts RF output—and match coax, balanced lines or random wires from 1.8 thru 30 MHz. Use it to tune out SWR on dipoles, vees, long wires, verticals, whips, beams and quads.

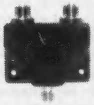
A 300 watt 50 ohm dummy load gives you quick tune ups and a versatile six position antenna switch lets you select 2 coax lines (direct or thru tuner), random wire or balanced line and dummy load.

A large efficient airwound inductor—3 inches in diameter—gives you plenty of matching range and less losses for more watts out. 100 volt tuning capacitors and heavy duty switches gives you safe arc-free operation. A 4:1 balun is built-in to match balanced lines.

Order your convenience package now and enjoy.

2 KW COAX SWITCHES

MFJ-1702 **$19.95**



MFJ-1702, $19.95. 2 positions. 60 dB isolation at 450 MHz. Less than .2 dB loss. SWR below 1:1.2.

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MFJ's ultra compact 200 watt random wire tuner lets you operate all bands anywhere with any transceiver using a random wire. Great for apartment, motel, camping operation. Tunes 1.8-30 MHz. 2 x 3 x 4 inches.

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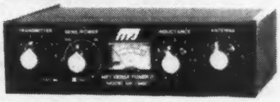

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Your company name and message can contain up to 25 words for as little as $150 yearly (prepaid), or $15 per month (prepaid quarterly). No mention of mail-order business or area code permitted. Directory text and payment must reach us 60 days in advance of publication. For example, advertising for the December '86 issue must be in our hands by October 1st. Mail to *73 Amateur Radio*, WGE Center, Peterborough, NH 03458. ATTN: Hope Currier.

PROPAGATION

Jim Gray W1XU

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40	40		20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U. S. S. R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U. S. S. R.								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U. S. S. R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

September should bring some very disturbed conditions blended with excellent fall propagation on the HF bands. Expect an unsettled geomagnetic field on the 1st and 2nd, and an active field from the 5th or 6th through the 10th. We may see the return of significant sunspot activity—and possibly a flare! Earthquakes and volcanic eruptions possible around the 2nd and 11th.

G=Good, F=Fair, P=Poor, *=Disturbed magnetic field coupled with some unusual geophysical conditions (50–75% probability).

SEPTEMBER

SUN	MON	TUE	WED	THU	FRI	SAT
	1 F	2 P	3 F	4 G	5 *	6 *
7 *	8 *	9 F	10 F–G	11 P	12 F	13 G
14 F–P	15 P–F	16 F–G	17 G	18 G	19 G	20 G
21 G	22 G	23 G	24 F	25 F–P	26 P	27 P–F
28 G	29 G	30 G				

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- HF Transceiver
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- **High stability, dual digital VFOs.** An optical encoder and the flywheel VFO knob give the TS-940S a positive tuning "feel."
- **Graphic display of operating features.** Exclusive multi-function LCD sub-display panel shows CW VBT, SSB slope tuning, as well as frequency, time, and AT- 940 antenna tuner status.
- **Low distortion transmitter.** Kenwood's unique transmitter design delivers top "quality Kenwood" sound.
- **Keyboard entry frequency selection.** Operating frequencies may be directly entered into the TS-940S without using the VFO knob.
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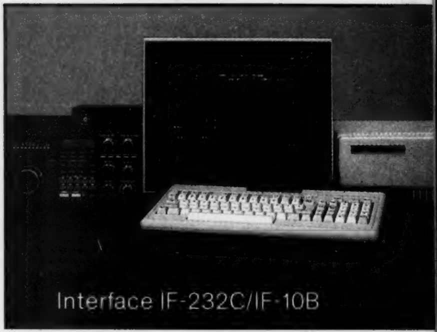
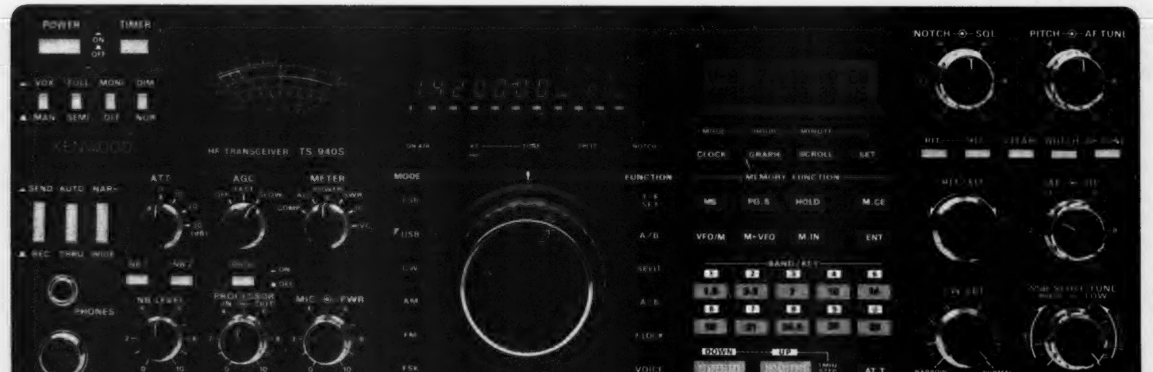
• AT-940 full range (160-10m) automatic antenna tuner • SP-940 external speaker with audio filtering • YG-455C-1 (500 Hz), YG-455CN-1 (250 Hz), YK-88C-1 (500 Hz) CW filters; YK-88A-1 (6 kHz) AM filter • VS-1 voice synthesizer • SO-1 temperature compensated crystal oscillator • MC-42S UP/DOWN hand mic. • MC-60A, MC-80, MC-85 deluxe base station mics. • PC-1A phone patch • TL- 922A linear amplifier • SM-220 station monitor • BS-8 pan display • SW-200A and SW-2000 SWR and power meters.



Interface IF-232C/IF-10B



25th Anniversary

Complete service manuals are available for all Trio-Kenwood transceivers and most accessories.
Specifications and prices are subject to change without notice or obligation.

More TS-940S information is available from authorized Kenwood dealers.

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